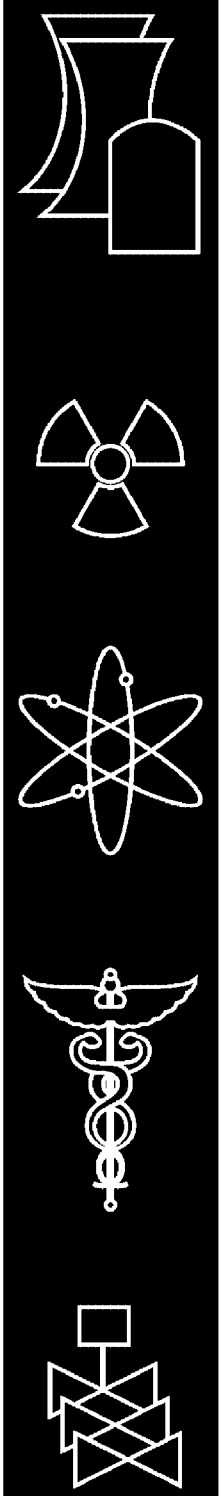

Generic Aging Lessons Learned (GALL) Report

Summary

U.S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Washington, DC 20555-0001

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Generic Aging Lessons Learned (GALL) Report

Summary

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Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

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Abstract

The Generic Aging Lessons Learned (GALL) report contains the staff's generic evaluation of the existing plant programs and documents the technical basis for determining where existing programs are adequate without modification and where existing programs should be augmented for the extended period of operation. The evaluation results documented in the GALL report indicate that many of the existing programs are adequate to manage the aging effects for particular structures or components for license renewal without change. The GALL report also contains recommendations on specific areas for which existing programs should be augmented for license renewal. An applicant may reference the GALL report in a license renewal application to demonstrate that the programs at the applicant’s facility correspond to those reviewed and approved in the GALL report and that no further staff review is required. The focus of the staff review is on the augmented existing programs for license renewal. The incorporation of the GALL report information into NUREG-1800, “Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants,” as directed by the Commission, should improve the efficiency of the license renewal process.

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ABBREVIATIONS

ADS	automatic depressurization system
AFW	auxiliary feedwater
AMP	aging management program
ASME	American Society of Mechanical Engineers
B&W	Babcock & Wilcox
BWR	boiling water reactor
BWRVIP	boiling water reactor vessel internals project
CASS	cast austenitic stainless steel
CE	Combustion Engineering
CEA	control element assembly
CFR	Code of Federal Regulations
CFS	core flood system
CLB	current licensing basis
CRD	control rod drive
CRGT	control rod guide tube
CS	carbon steel
CVCS	chemical and volume control system
DHR	decay heat removal
DSCSS	drywell and suppression chamber spray system
ECCS	emergency core cooling system
EDG	emergency diesel generator
EQ	environmental qualification
FW	feedwater
GALL	generic aging lessons learned
HP	high pressure
HPCI	high-pressure coolant injection
HPCS	high-pressure core spray
HPSI	high-pressure safety injection
HVAC	heating, ventilation, and air conditioning
IASCC	irradiation-assisted stress corrosion cracking
IGA	intergranular attack
IGSCC	intergranular stress corrosion cracking
IR	insulation resistance
IRM	intermediate range monitor
ISI	inservice inspection
LER	licensee event report
LG	lower grid
LP	low pressure
LPCI	low-pressure coolant injection
LPCS	low-pressure core spray

ABBREVIATIONS (continued)

LPRM	low-power range monitor
LPSI	low-pressure safety injection
MIC	microbiologically influenced corrosion
MSR	moisture separator/reheater
NEI	Nuclear Energy Institute
NPAR	Nuclear Plant Aging Research
NPS	nominal pipe size
NRC	Nuclear Regulatory Commission
NSSS	nuclear steam supply system
NUMARC	Nuclear Management and Resources Council
ODSCC	outside diameter stress corrosion cracking
PWR	pressurized water reactor
PWSCC	primary water stress corrosion cracking
QA	quality assurance
RCCA	rod control cluster assembly
RCIC	reactor core isolation cooling
RCP	reactor coolant pump
RCPB	reactor coolant pressure boundary
RCS	reactor coolant system
RG	Regulatory Guide
RHR	residual heat removal
RWC	reactor water cleanup
RWT	refueling water tank
SC	suppression chamber
SCC	stress corrosion cracking
SDC	shutdown cooling
SFP	spent fuel pool
SG	steam generator
SLC	standby liquid control
SRM	source range monitor
SRM	staff requirement memorandum
SRP-LR	Standard Review Plan for License Renewal
TLAA	time-limited aging analysis
UCS	Union of Concerned Scientists
UV	ultraviolet

INTRODUCTION

By letter dated March 3, 1999, the Nuclear Energy Institute (NEI) documented the industry's views on how existing plant programs and activities should be credited for license renewal. The issue can be summarized as follows: To what extent should the staff review existing programs relied on for license renewal in determining whether an applicant has demonstrated reasonable assurance that such programs will be effective in managing the effects of aging on the functionality of structures and components in the period of extended operation? In a staff paper, SECY-99-148, "Credit for Existing Programs for License Renewal," dated June 3, 1999, the staff described options for crediting existing programs and recommended one option that the staff believed would improve the efficiency of the license renewal process.

By staff requirements memorandum (SRM), dated August 27, 1999, the Commission approved the staff's recommendation and directed the staff to focus the staff review guidance in the Standard Review Plan for License Renewal (SRP-LR) on areas where existing programs should be augmented for license renewal. The staff would develop a "Generic Aging Lessons Learned (GALL)" report to document the staff's evaluation of generic existing programs. The GALL report would document the staff's basis for determining which existing programs are adequate without modification and which existing programs should be augmented for license renewal. The GALL report would be referenced in the SRP-LR as a basis for determining the adequacy of existing programs.

GALL REPORT EVALUATION PROCESS

This report builds on a previous report, NUREG/CR-6490, "Nuclear Power Plant Generic Aging Lessons Learned (GALL)," which is a systematic compilation of plant aging information. This report extends the information in NUREG/CR-6490 to provide an evaluation of the adequacy of aging management programs for license renewal. The NUREG/CR-6490 report was based on information in over 500 documents: Nuclear Plant Aging Research (NPAR) program reports sponsored by the Office of Nuclear Regulatory Research, Nuclear Management and Resources Council (NUMARC, now NEI) industry reports addressing license renewal, licensee event reports (LERs), information notices, generic letters, and bulletins. The staff has also considered information contained in the reports provided by the Union of Concerned Scientists (UCS) in a letter dated May 5, 2000.

Following the general format of NUREG-0800 for major plant sections except for refueling water, chilled water, residual heat removal, condenser circulating water, and condensate storage system in pressurized water reactor (PWR) and boiling water reactor (BWR) power plants, the staff has reviewed the aging effects on components and structures, identified the relevant existing programs, and evaluated program attributes to manage aging effects for license renewal. This report was prepared with the technical assistance of Argonne National Laboratory and Brookhaven National Laboratory. As directed in the SRM, this report has the benefit of the experience of the staff members who conducted the review of the initial license renewal applications. Also, as directed in the SRM, the staff has sought stakeholders' participation in the development of this report. The staff held many public meetings and workshops to solicit input from the public. The staff also issued the draft improved license renewal guidance documents, including the GALL report, for public comments in the Federal Register Notice, Vol. 65, No. 170, August 31, 2000. The staff's analysis of stakeholder comments is documented in NUREG-1739.

The results of the GALL effort are presented in a table format in the GALL report, Volume 2. The table column headings are: Item, Structure and/or Component, Material, Environment, Aging Effect/Mechanism, Aging Management Program (AMP), and Further Evaluation. The staff's evaluation of the adequacy of each generic aging management program in managing certain aging effects for particular structures and components is based on the review of the following 10 program attributes (or elements):

Element	Description
1. Scope of the program	The scope of the program should include the specific structures and components subject to an aging management review.
2. Preventive actions	Preventive actions should mitigate or prevent the applicable aging effects.
3. Parameters monitored or inspected	Parameters monitored or inspected should be linked to the effects of aging on the intended functions of the particular structure and component.
4. Detection of aging effects	Detection of aging effects should occur before there is a loss of any structure and component intended function. This includes aspects such as method or technique (i.e., visual, volumetric, surface inspection), frequency, sample size, data collection and timing of new/one-time inspections to ensure timely detection of aging effects.
5. Monitoring and trending	Monitoring and trending should provide for prediction of the extent of the effects of aging and timely corrective or mitigative actions.
6. Acceptance criteria	Acceptance criteria, against which the need for corrective action will be evaluated, should ensure that the particular structure and component intended functions are maintained under all current licensing basis (CLB) design conditions during the period of extended operation.
7. Corrective actions	Corrective actions, including root cause determination and prevention of recurrence, should be timely.
8. Confirmation process	The confirmation process should ensure that preventive actions are adequate and appropriate corrective actions have been completed and are effective.
9. Administrative controls	Administrative controls should provide a formal review and approval process.
10. Operating experience	Operating experience involving the aging management program, including past corrective actions resulting in program enhancements or additional programs, should provide objective evidence to support a determination that the effects of aging will be adequately managed so that the structure and component intended functions will be maintained during the period of extended operation.

If, on the basis of its evaluation, the staff determines that a program is adequate to manage certain aging effects for a particular structure or component without change, the “Further Evaluation” entry would indicate that no further staff evaluation is recommended for license renewal. Otherwise, the entry would recommend areas in which the staff should focus its review. The Commission’s regulations in 10 CFR 54.21(c) require an evaluation of time-limited aging analyses (TLAAs). Examples of TLAAs are applicant analyses of metal fatigue and environmental qualification (EQ) of electric equipment. The GALL report in general refers the reader to the SRP-LR for guidance on how TLAAs should be evaluated. However, 10 CFR 54.21(c)(1)(iii) allows a TLAA-associated aging effect to be managed by an aging management program. The GALL report, Volume 2, Chapter X, provides the staff’s evaluation of several TLAAs under 10 CFR 54.21(c)(1)(iii) based on the initial license renewal reviews.

Chapter XI of the GALL report, Volume 2, contains the staff's evaluation of generic aging management programs that are relied on in the GALL report, such as the ASME Section XI inservice inspection, water chemistry, or structures monitoring program.

APPLICATION OF THE GALL REPORT

The GALL report is a technical basis document to the SRP-LR, which provides the staff with guidance in reviewing a license renewal application. The GALL report should be treated in the same manner as an approved topical report that is generically applicable. An applicant may reference the GALL report in a license renewal application to demonstrate that the programs at the applicant’s facility correspond to those reviewed and approved in the GALL report and that no further staff review is required, as described in the next paragraph. If the material presented in the GALL report is applicable to the applicant’s facility, the staff should find the applicant’s reference to the GALL report acceptable. In making this determination, the staff should consider whether the applicant has identified specific programs described and evaluated in the GALL report. The staff, however, should not conduct a re-review of the substance of the matters described in the GALL report. Rather, the staff should ensure that the applicant verifies that the approvals set forth in the GALL report for generic programs apply to the applicant’s programs. The focus of the staff review should be on augmented programs for license renewal. The staff should also review information that is not addressed in the GALL report or is otherwise different from that in the GALL report.

If an applicant takes credit for a program in GALL, it is incumbent on the applicant to ensure that the plant program contains all the elements of the referenced GALL program. In addition, the conditions at the plant must be bounded by the conditions for which the GALL program was evaluated. The above verifications must be documented on-site in an auditable form. The applicant must include a certification in the license renewal application that the verifications have been completed and are documented on-site in an auditable form.

The GALL report contains one acceptable way to manage aging effects for license renewal. An applicant may propose alternatives for staff review in its plant-specific license renewal application. Use of the GALL report is not required, but its use should facilitate both preparation of a license renewal application by an applicant and timely, uniform review by the NRC staff.

In addition, the GALL report does not address scoping of structures and components for license renewal. Scoping is plant specific, and the results depend on the plant design and current licensing basis. The inclusion of a certain structure or component in the GALL report does not mean that this particular structure or component is within the scope of license renewal for all plants. Conversely, the omission of a certain structure or component in the GALL report does

not mean that this particular structure or component is not within the scope of license renewal for any plants.

SUMMARY AND RECOMMENDATIONS

The GALL report contains an evaluation of a large number of structures and components. The evaluation results documented in the GALL report indicate that many of the generic existing programs are adequate to manage aging effects for particular structures or components for license renewal without change. The GALL report also contains recommendations on specific areas for which generic existing programs should be augmented for license renewal and documents the technical basis for each such determination.

In the GALL report, Volume 1, Tables 1 through 6 are summaries of the aging management review. These tables are the same as Tables 3.1-1 to 3.6-1, respectively, in the SRP-LR, except for an additional sixth column in Tables 1 to 6 that identifies the specific item numbers assigned to each structure and/or component (i.e., each row in the section tables contained in Volume 2 of the GALL report). Descriptions of the specific item numbers used in the GALL report, Volume 2, Chapters II through VIII, are given in the Appendix of Volume 1. A locator for the plant systems evaluated in Volume 2 is also provided in the Appendix of Volume 1. The specific item number and associated aging effect serve as a pointer to the technical evaluation for the specific structure and component addressed in Volume 2 (Tabulation of Results).

The Appendix of Volume 2 of the GALL report addresses quality assurance (QA) for aging management programs. Those aspects of the aging management review process that affect the quality of safety-related structures, systems, and components are subject to the QA requirements of Appendix B to 10 CFR Part 50. For nonsafety-related structures and components subject to an aging management review, the existing 10 CFR Part 50, Appendix B, QA program may be used by an applicant to address the elements of the corrective actions, confirmation process, and administrative controls for an aging management program for license renewal.

The GALL report provides a technical basis for crediting existing plant programs and recommending areas for program augmentation and further evaluation. The incorporation of the GALL report information into the SRP-LR, as directed by the Commission, should improve the efficiency of the license renewal process and better focus staff resources.

Table 1. Summary of Aging Management Programs for the Reactor Coolant System Evaluated in Chapter IV of the GALL Report

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Item Number in GALL
BWR/ PWR	Reactor coolant pressure boundary components	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA	IV.A1.1-b, IV.A1.2-a, IV.A1.2-b, IV.A1.3-a, IV.A1.3-d, IV.A1.4-b, IV.A1.5-b, IV.A1.6-a, IV.A1.7-a, IV.A2.1-b, IV.A2.1-e, IV.A2.2-c, IV.A2.3-c, IV.A2.4-a, IV.A2.5-d, IV.A2.8-a, IV.B1.1-c, IV.B1.2-b, IV.B1.3-b, IV.B1.4-b, IV.B1.5-b, IV.B1.6-b, IV.B2.1-c, IV.B2.1-h, IV.B2.1-m, IV.B2.2-c, IV.B2.2-f, IV.B2.3-d, IV.B2.4-g, IV.B2.5-d, IV.B2.5-j, IV.B2.5-p, IV.B3.2-f, IV.B3.4-d, IV.B3.5-g, IV.B4.1-d, IV.B4.2-d, IV.B4.3-f, IV.B4.4-e, IV.B4.5-f, IV.B4.6-f, IV.C1.1-b, IV.C1.1-d, IV.C1.1-e, IV.C1.1-h, IV.C1.2-a, IV.C1.2-f, IV.C1.3-d,

Table 1. Summary of Aging Management Programs for the Reactor Coolant System Evaluated in Chapter IV of the GALL Report (continued)

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Item Number in GALL
BWR/ PWR	Reactor coolant pressure boundary components	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA	IV.C1.3-g, IV.C2.1-a, IV.C2.1-b, IV.C2.2-a, IV.C2.2-b, IV.C2.2-c, IV.C2.3-a, IV.C2.3-d, IV.C2.4-a, IV.C2.4-d, IV.C2.5-a, IV.C2.5-d, IV.C2.5-e, IV.C2.5-f, IV.C2.5-q, IV.C2.5-t, IV.C2.5-w, IV.C2.6-a, IV.D1.1-a, IV.D1.1-b, IV.D1.1-h, IV.D1.2-d, IV.D2.1-c, IV.D2.1-g, IV.D2.2-e.
PWR	Steam generator shell assembly	Loss of material due to pitting and crevice corrosion	Inservice inspection; water chemistry	Yes, detection of aging effects is to be further evaluated	IV.D1.1-c, IV.D2.1-e.
BWR	Isolation condenser	Loss of material due to general, pitting, and crevice corrosion	Inservice inspection; water chemistry	Yes, plant specific	IV.C1.4-b.
BWR/ PWR	Pressure vessel ferritic materials that have a neutron fluence greater than 10^{17} n/cm^2 (E>1 MeV)	Loss of fracture toughness due to neutron irradiation embrittlement	TLAA, evaluated in accordance with Appendix G of 10 CFR 50 and RG 1.99	Yes, TLAA	IV.A1.2-c, IV.A1.3-e, IV.A2.3-a, IV.A2.5-a.
BWR/ PWR	Reactor vessel beltline shell and welds	Loss of fracture toughness due to neutron irradiation embrittlement	Reactor vessel surveillance	Yes, plant specific	IV.A1.2-d, IV.A2.3-b, IV.A2.5-c.
PWR	Westinghouse and Babcock & Wilcox (B&W) baffle/ former bolts	Loss of fracture toughness due to neutron irradiation embrittlement and void swelling	Plant specific	Yes, plant specific	IV.B2.4-f, IV.B4.5-i.

Table 1. Summary of Aging Management Programs for the Reactor Coolant System Evaluated in Chapter IV of the GALL Report (continued)

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Item Number in GALL
BWR/ PWR	Small-bore reactor coolant system and connected systems piping	Crack initiation and growth due to stress corrosion cracking (SCC), intergranular stress corrosion cracking (IGSCC), and thermal and mechanical loading	Inservice inspection; water chemistry; one-time inspection	Yes, parameters monitored/ inspected and detection of aging effects are to be further evaluated	IV.C1.1-i, IV.C2.1-g, IV.C2.2-h.
BWR	Jet pump sensing line and reactor vessel flange leak detection line	Crack initiation and growth due to SCC, IGSCC, or cyclic loading	Plant specific	Yes, plant specific	IV.A1.1-d, IV.B1.4-d.
BWR	Isolation condenser	Crack initiation and growth due to SCC or cyclic loading	Inservice inspection; water chemistry	Yes, plant specific	IV.C1.4-a.
PWR	Vessel shell	Crack growth due to cyclic loading	TLAA	Yes, TLAA	IV.A2.5-b.
PWR	Reactor internals	Changes in dimension due to void swelling	Plant specific	Yes, plant specific	IV.B2.1-b, IV.B2.1-f, IV.B2.1-j, IV.B2.2-b, IV.B2.2-e, IV.B2.3-b, IV.B2.4-b, IV.B2.4-d, IV.B2.5-b, IV.B2.5-f, IV.B2.5-l, IV.B2.6-b, IV.B3.1-b, IV.B3.2-c, IV.B3.3-b, IV.B3.4-b, IV.B3.4-f, IV.B3.5-c, IV.B4.1-c, IV.B4.2-c, IV.B4.3-c, IV.B4.4-c, IV.B4.5-c, IV.B4.5-h, IV.B4.6-c, IV.B4.7-c, IV.B4.8-b.

Table 1. Summary of Aging Management Programs for the Reactor Coolant System Evaluated in Chapter IV of the GALL Report (continued)

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Item Number in GALL
PWR	PWR core support pads, instrument tubes (bottom head penetrations), pressurizer spray heads, and nozzles for the steam generator instruments and drains	Crack initiation and growth due to SCC and/or primary water stress corrosion cracking (PWSCC)	Plant specific	Yes, plant specific	IV.A2.1-f, IV.A2.6-a, IV.A2.7-a, IV.C2.5-j, IV.D1.1-j, IV.D2.1-h, IV.D2.1-i.
PWR	Cast austenitic stainless steel (CASS) reactor coolant system piping	Crack initiation and growth due to SCC	Plant specific	Yes, plant specific	IV.C2.1-e, IV.C2.2-g, IV.C2.5-i.
PWR	Pressurizer instrumentation penetrations and heater sheaths and sleeves made of Ni-alloys	Crack initiation and growth due to PWSCC	Inservice inspection; water chemistry	Yes, AMP for PWSCC of Inconel 182 weld is to be evaluated	IV.C2.5-k, IV.C2.5-s.
PWR	Westinghouse and B&W baffle former bolts	Crack initiation and growth due to SCC and irradiation-assisted stress corrosion cracking (IASCC)	Plant specific	Yes, plant specific	IV.B2.4-c, IV.B4.5-g.
PWR	Westinghouse and B&W baffle former bolts	Loss of preload due to stress relaxation	Plant specific	Yes, plant specific	IV.B2.4-h, IV.B4.5-j.
PWR	Steam generator feedwater impingement plate and support	Loss of section thickness due to erosion	Plant specific	Yes, plant specific	IV.D1.1-e.

Table 1. Summary of Aging Management Programs for the Reactor Coolant System Evaluated in Chapter IV of the GALL Report (continued)

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Item Number in GALL
PWR	(Alloy 600) Steam generator tubes, repair sleeves, and plugs	Crack initiation and growth due to PWSCC, outside diameter stress corrosion cracking (ODSCC), and/or intergranular attack (IGA); or loss of material due to wastage and pitting corrosion, and fretting and wear; or deformation due to corrosion at tube support plate intersections	Steam generator tubing integrity; water chemistry	Yes, effectiveness of a proposed AMP is to be evaluated	IV.D1.2-a, IV.D1.2-b, IV.D1.2-c, IV.D1.2-e, IV.D1.2-f, IV.D1.2-g, IV.D1.2-i, IV.D1.2-j, IV.D2.2-a, IV.D2.2-b, IV.D2.2-c, IV.D2.2-d, IV.D2.2-f, IV.D2.2-g.
PWR	Tube support lattice bars made of carbon steel	Loss of section thickness due to flow-accelerated corrosion (FAC)	Plant specific	Yes, plant specific	IV.D1.2-h.
PWR	Carbon steel tube support plate	Ligament cracking due to corrosion	Plant specific	Yes, effectiveness of a proposed AMP is to be evaluated	IV.D1.2-k.
PWR (CE)	Steam generator feedwater inlet ring and supports	Loss of material due to flow accelerated corrosion	Combustion Engineering (CE) steam generator feedwater ring inspection	Yes, plant specific	IV.D1.3-a.
BWR/ PWR	Reactor vessel closure studs and stud assembly	Crack initiation and growth due to SCC and/or IGSCC	Reactor head closure studs	No	IV.A1.1-c, IV.A2.1-c.
BWR/ PWR	CASS pump casing and valve body	Loss of fracture toughness due to thermal aging embrittlement	Inservice inspection	No	IV.C1.2-c, IV.C1.3-b, IV.C2.3-c, IV.C2.4-c.
BWR/ PWR	CASS piping	Loss of fracture toughness due to thermal aging embrittlement	Thermal aging embrittlement of CASS	No	IV.A2.2-d, IV.C1.1-g, IV.C2.1-f, IV.C2.2-e, IV.C2.5-l.
BWR/ PWR	BWR piping and fittings; steam generator components	Wall thinning due to flow accelerated corrosion	Flow accelerated corrosion	No	IV.C1.1-a, IV.C1.1-c, IV.C1.3-a, IV.D1.1-d, IV.D2.1-f.

Table 1. Summary of Aging Management Programs for the Reactor Coolant System Evaluated in Chapter IV of the GALL Report (continued)

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Item Number in GALL
BWR/ PWR	Reactor coolant pressure boundary (RCPB) valve closure bolting, manway and holding bolting, and closure bolting in high-pressure and high-temperature systems	Loss of material due to wear; loss of preload due to stress relaxation; crack initiation and growth due to cyclic loading and/or SCC	Bolting integrity	No	IV.A2.2-e, IV.A2.2-f, IV.A2.2-g, IV.C1.2-d, IV.C1.2-e, IV.C1.3-e, IV.C1.3-f, IV.C2.3-e, IV.C2.3-g, IV.C2.4-e, IV.C2.4-g, IV.C2.5-n, IV.C2.5-p, IV.D1.1-f, IV.D1.1-l, IV.D2.1-k.
BWR	Feedwater and control rod drive (CRD) return line nozzles	Crack initiation and growth due to cyclic loading	Feedwater nozzle; CRD return line nozzle	No	IV.A1.3-b, IV.A1.3-c.
BWR	Vessel shell attachment welds	Crack initiation and growth due to SCC and/or IGSCC	BWR vessel ID attachment welds; water chemistry	No	IV.A1.2-e.
BWR	Nozzle safe ends, recirculation pump casing, connected systems piping and fittings, body and bonnet of valves	Crack initiation and growth due to SCC and/or IGSCC	BWR stress corrosion cracking; water chemistry	No	IV.A1.4-a, IV.C1.1-f, IV.C1.2-b, IV.C1.3-c.
BWR	Penetrations	Crack initiation and growth due to SCC, IGSCC, and/or cyclic loading	BWR bottom head penetrations; water chemistry	No	IV.A1.5-a.

Table 1. Summary of Aging Management Programs for the Reactor Coolant System Evaluated in Chapter IV of the GALL Report (continued)

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Item Number in GALL
BWR	Core shroud and core plate, support structure, top guide, core spray lines and spargers, jet pump assemblies, control rod drive housing, and nuclear instrumentation guide tubes	Crack initiation and growth due to SCC, IGSCC, and/or IASCC	BWR vessel internals; water chemistry	No	IV.B1.1-a, IV.B1.1-b, IV.B1.1-f, IV.B1.1-g, IV.B1.2-a, IV.B1.3-a, IV.B1.4-a, IV.B1.5-c, IV.B1.6-a.
BWR	Core shroud and core plate access hole cover (welded and mechanical covers)	Crack initiation and growth due to SCC, IGSCC, and/or IASCC	ASME Section XI inservice inspection; water chemistry	No	IV.B1.1-d, IV.B1.1-e.
BWR	Jet pump assembly castings and orificed fuel support	Loss of fracture toughness due to thermal aging and neutron irradiation embrittlement	Thermal aging and neutron irradiation embrittlement	No	IV.B1.4-c, IV.B1.5-a.
BWR	Unclad top head and nozzles	Loss of material due to general, pitting, and crevice corrosion	Inservice inspection; water chemistry	No	IV.A1.1-a.
PWR	CRD nozzle	Crack initiation and growth due to PWSCC	Ni-alloy nozzles and penetrations; water chemistry	No	IV.A2.2-a, IV.A2.7-b.
PWR	Reactor vessel nozzles safe ends and CRD housing; reactor coolant system components (except CASS and bolting)	Crack initiation and growth due to cyclic loading, and/or SCC, and PWSCC	Inservice inspection; water chemistry	No	IV.A2.2-b, IV.A2.4-b, IV.C2.1-c, IV.C2.2-f, IV.C2.3-b, IV.C2.4-b, IV.C2.5-c, IV.C2.5-g, IV.C2.5-h, IV.C2.5-m, IV.C2.5-r, IV.C2.6-c.

Table 1. Summary of Aging Management Programs for the Reactor Coolant System Evaluated in Chapter IV of the GALL Report (continued)

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Item Number in GALL
PWR	Reactor vessel internals CASS components	Loss of fracture toughness due to thermal aging, neutron irradiation embrittlement, and void swelling	Thermal aging and neutron irradiation embrittlement	No	IV.B2.1-g, IV.B2.5-m, IV.B3.2-e, IV.B3.5-f, IV.B4.3-d, IV.B4.4-g, IV.B4.6-e.
PWR	External surfaces of carbon steel components in reactor coolant system pressure boundary	Loss of material due to boric acid corrosion	Boric acid corrosion	No	IV.A2.1-a, IV.A2.5-e, IV.A2.8-b, IV.C2.1-d, IV.C2.2-d, IV.C2.3-f, IV.C2.4-f, IV.C2.5-b, IV.C2.5-o, IV.C2.5-u, IV.C2.6-b, IV.D1.1-g, IV.D1.1-k, IV.D2.1-b, IV.D2.1-j.
PWR	Steam generator secondary manways and handholds (carbon steel)	Loss of material due to erosion	Inservice inspection	No	IV.D2.1-l.
PWR	Reactor internals, reactor vessel closure studs, and core support pads	Loss of material due to wear	Inservice inspection	No	IV.A2.5-f, IV.B2.1-l, IV.B2.5-o, IV.B2.6-c, IV.B3.1-c, IV.B3.2-d, IV.B3.3-b, IV.B3.5-e, IV.B4.2-f, IV.B4.4-f, IV.B4.6-h.
PWR	Pressurizer integral support	Crack initiation and growth due to cyclic loading	Inservice inspection	No	IV.C2.5-v.
PWR	Upper and lower internals assembly (Westinghouse)	Loss of preload due to stress relaxation	Inservice inspection; loose part and/or neutron noise monitoring	No	IV.B2.1-d, IV.B2.5-i.

Table 1. Summary of Aging Management Programs for the Reactor Coolant System Evaluated in Chapter IV of the GALL Report (continued)

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Item Number in GALL
PWR	Reactor vessel internals in fuel zone region (except Westinghouse and B&W baffle former bolts)	Loss of fracture toughness due to neutron irradiation embrittlement and void swelling	PWR vessel internals; water chemistry	No	IV.B2.3-c, IV.B2.4-e, IV.B2.5-c, IV.B2.5-g, IV.B2.5-n, IV.B3.3-a, IV.B3.4-c, IV.B3.4-g, IV.B3.5-d, IV.B4.2-e IV.B4.4-d, IV.B4.5-d, IV.B4.6-d, IV.B4.7-d, IV.B4.8-c.
PWR	Steam generator upper and lower heads, tubesheets, and primary nozzles and safe ends	Crack initiation and growth due to SCC, PWSCC, and/or IASCC	Inservice inspection; water chemistry	No	IV.D1.1-i, IV.D2.1-a.

Table 1. Summary of Aging Management Programs for the Reactor Coolant System Evaluated in Chapter IV of the GALL Report (continued)

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Item Number in GALL
PWR	Vessel internals (except Westinghouse and B&W baffle former bolts)	Crack initiation and growth due to SCC and IASCC	PWR vessel internals; water chemistry	No	IV.B2.1-a, IV.B2.1-e, IV.B2.1-i, IV.B2.2-a, IV.B2.2-d, IV.B2.3-a, IV.B2.4-a, IV.B2.5-a, IV.B2.5-e, IV.B2.5-k, IV.B2.6-a, IV.B3.1-a, IV.B3.2-a, IV.B3.2-b, IV.B3.3-a, IV.B3.4-a, IV.B3.4-e, IV.B3.5-a, IV.B3.5-b, IV.B4.1-a, IV.B4.1-b, IV.B4.2-a, IV.B4.2-b, IV.B4.3-a, IV.B4.3-b, IV.B4.4-a, IV.B4.4-b, IV.B4.5-a, IV.B4.5-b, IV.B4.6-a, IV.B4.6-b, IV.B4.7-a, IV.B4.7-b, IV.B4.8-a.
PWR	Reactor internals (B&W screws and bolts)	Loss of preload due to stress relaxation	Inservice inspection; loose part monitoring	No	IV.B4.3-e, IV.B4.4-h, IV.B4.5-e, IV.B4.6-g, IV.B4.7-e.
PWR	Reactor vessel closure studs and stud assembly	Loss of material due to wear	Reactor head closure studs	No	IV A2.1-d.

Table 1. Summary of Aging Management Programs for the Reactor Coolant System Evaluated in Chapter IV of the GALL Report (continued)

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Item Number in GALL
PWR	Reactor internals (Westinghouse upper and lower internal assemblies, CE bolts and tie rods)	Loss of preload due to stress relaxation	Inservice inspection; loose part monitoring	No	IV.B2.1-k, IV.B2.5-h, IV.B3.2-g, IV.B3.4-h.

Table 2. Summary of Aging Management Programs for the Engineered Safety Features Evaluated in Chapter V of the GALL Report

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Item Number in GALL
BWR/ PWR	Piping, fittings, and valves in emergency core cooling system	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA	V.D1.1-c, V.D1.4-a, V.D2.1-b.
BWR	Piping, fittings, pumps, and valves in emergency core cooling system	Loss of material due to general corrosion	Water chemistry and one-time inspection	Yes, detection of aging effects is to be further evaluated	V.D2.1-a, V.D2.2-a, V.D2.3-b.
BWR/ PWR	Components in containment spray (PWR only), standby gas treatment system (BWR only), containment isolation, and emergency core cooling systems	Loss of material due to general corrosion	Plant specific	Yes, plant specific	V.A.2-a, V.A.5-a, V.B.1-a, V.B.2-a, V.C.1-a, V.D2.1-e, V.D2.5-a.
BWR	Piping, fittings, pumps, and valves in emergency core cooling system	Loss of material due to pitting and crevice corrosion	Water chemistry and one-time inspection	Yes, detection of aging effects is to be further evaluated	V.D2.1-a, V.D2.2-a, V.D2.3-b.
BWR/ PWR	Components in containment spray (PWR only), standby gas treatment system (BWR only), containment isolation, and emergency core cooling systems	Loss of material due to pitting and crevice corrosion	Plant specific	Yes, plant specific	V.C.1-a, V.C.1-b, V.D1.8-c, V.D2.1-e.
BWR/ PWR	Containment isolation valves and associated piping	Loss of material due to microbiologically influenced corrosion (MIC)	Plant specific	Yes, plant specific	V.C.1-a, V.C.1-b.
BWR	Seals in standby gas treatment system	Changes in properties due to elastomer degradation	Plant specific	Yes, plant specific	V.B.1-b, V.B.2-b.

Table 2. Summary of Aging Management Programs for the Engineered Safety Features Evaluated in Chapter V of the GALL Report (continued)

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Item Number in GALL
PWR	High-pressure safety injection (charging) pump miniflow orifice	Loss of material due to erosion	Plant specific	Yes, plant specific	V.D1.2-c.
BWR	Drywell and suppression chamber spray system nozzles and flow orifices	Plugging of flow orifice and spray nozzles by general corrosion products	Plant specific	Yes, plant specific	V.D2.5-b.
BWR/ PWR	External surface of carbon steel components	Loss of material due to general corrosion	Plant specific	Yes, plant specific	V.E.1-b.
BWR/ PWR	Piping and fittings of CASS in emergency core cooling systems	Loss of fracture toughness due to thermal aging embrittlement	Thermal aging embrittlement of CASS	No	V.D1.1-b, V.D2.1-d.
BWR/ PWR	Components serviced by open-cycle cooling system	Loss of material due to general, pitting, and crevice corrosion, MIC, and biofouling; buildup of deposit due to biofouling	Open-cycle cooling water system	No	V.A.6-a, V.A.6-b, V.D1.6-b, V.D1.6-c, V.D2.4-a, V.D2.4-b.
BWR/ PWR	Components serviced by closed-cycle cooling system	Loss of material due to general, pitting, and crevice corrosion	Closed-cycle cooling water system	No	V.A.6-c, V.D1.5-a, V.D1.6-a, V.D2.4-c.
BWR	Emergency core cooling system valves and lines to and from high-pressure coolant injection (HPCI) and reactor core isolation cooling (RCIC) pump turbines	Wall thinning due to flow-accelerated corrosion	Flow-accelerated corrosion	No	V.D2.1-f, V.D2.3-a.
PWR	Pumps, valves, piping and fittings, and tanks in containment spray and emergency core cooling system	Crack initiation and growth due to SCC	Water chemistry	No	V.A.1-a, V.A.1-c, V.A.3-a, V.A.4-a, V.D1.1-a, V.D1.2-a, V.D1.4-b, V.D1.7-b, V.D1.8-a.

Table 2. Summary of Aging Management Programs for the Engineered Safety Features Evaluated in Chapter V of the GALL Report (continued)

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Item Number in GALL
BWR	Pumps, valves, piping and fittings in emergency core cooling system	Crack initiation and growth due to SCC and IGSCC	Water chemistry and BWR stress corrosion cracking	No	V.D2.1-c, V.D2.3-c.
PWR	Carbon steel components	Loss of material due to boric acid corrosion	Boric acid corrosion	No	V.A.1-b, V.A.3-b, V.A.4-b, V.A.5-b, V.A.6-d, V.D1.1-d, V.D1.2-b, V.D1.3-a, V.D1.4-c, V.D1.5-b, V.D1.6-d, V.D1.7-a, V.D1.8-b, V.E.1-a.
BWR/ PWR	Closure bolting in high-pressure or high-temperature systems	Loss of material due to general corrosion; crack initiation and growth due to cyclic loading and/or SCC	Bolting integrity	No	V.E.2-a, V.E.2-b.

Table 3. Summary of Aging Management Programs for the Auxiliary Systems Evaluated in Chapter VII of the GALL Report

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Item Number in GALL
BWR/ PWR	Components in spent fuel pool cooling and cleanup	Loss of material due to general, pitting, and crevice corrosion	Water chemistry and one-time inspection	Yes, detection of aging effects is to be further evaluated	VII.A3.2-a, VII.A3.3-a, VII.A3.5-a, VII.A4.1-a, VII.A4.2-a, VII.A4.3-a, VII.A4.4-b, VII.A4.5-a, VII.A4.6-a.
BWR/ PWR	Linings in spent fuel pool cooling and cleanup system; seals and collars in ventilation systems	Hardening, cracking and loss of strength due to elastomer degradation; loss of material due to wear	Plant specific	Yes, plant specific	VII.A3.2-d, VII.A3.3-d, VII.A3.5-c, VII.A4.2-b, VII.A4.3-b, VII.A4.5-b, VII.F1.1-b, VII.F1.1-c, VII.F1.4-b, VII.F2.1-b, VII.F2.1-c, VII.F2.4-b, VII.F3.1-b, VII.F3.1-c, VII.F3.4-b, VII.F4.1-b, VII.F4.1-c.
BWR/ PWR	Components in load handling, chemical and volume control system (PWR), and reactor water cleanup and shutdown cooling systems (older BWR)	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA	VII.B.1-a, VII.E1.1-a, VII.E1.3-a, VII.E1.7-a, VII.E1.8-a, VII.E3.1-b, VII.E3.2-b, VII.E3.2-c, VII.E4.1-b.
BWR/ PWR	Heat exchangers in reactor water cleanup system (BWR); high pressure pumps in chemical and volume control system (PWR)	Crack initiation and growth due to SCC or cracking	Plant specific	Yes, plant specific	VII.E1.5-a, VII.E3.3-d, VII.E3.4-a.

Table 3. Summary of Aging Management Programs for the Auxiliary Systems Evaluated in Chapter VII of the GALL Report (continued)

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Item Number in GALL
BWR/ PWR	Components in ventilation systems, diesel fuel oil system, and emergency diesel generator systems; external surfaces of carbon steel components	Loss of material due to general, pitting, and crevice corrosion, and MIC	Plant specific	Yes, plant specific	VII.F1.1-a, VII.F1.2-a, VII.F1.4-a, VII.F2.1-a, VII.F2.2-a, VII.F2.4-a, VII.F3.1-a, VII.F3.2-a, VII.F3.4-a, VII.F4.1-a, VII.F4.2-a, VII.H1.1-a, VII.H1.2-a, VII.H1.3-a, VII.H2.2-a, VII.H2.3-a, VII.H2.4-a, VII. I1-b.
BWR/ PWR	Components in reactor coolant pump oil collect system of fire protection	Loss of material due to galvanic, general, pitting, and crevice corrosion	One-time inspection	Yes, detection of aging effects is to be further evaluated	VII.G.7-a, VII.G.7-b.
BWR/ PWR	Diesel fuel oil tanks in diesel fuel oil system and emergency diesel generator system	Loss of material due to general, pitting, and crevice corrosion, MIC, and biofouling	Fuel oil chemistry and one-time inspection	Yes, detection of aging effects is to be further evaluated	VII.H1.4-a, VII.H2.5-a.
BWR	Piping, pump casing, and valve body and bonnets in shutdown cooling system (older BWR)	Loss of material due to pitting and crevice corrosion	Water chemistry and one-time inspection	Yes, detection of aging effects is to be further evaluated	VII.E4.1-a, VII.E4.2-a.
PWR	Heat exchangers in chemical and volume control system	Crack initiation and growth due to SCC and cyclic loading	Water chemistry and a plant-specific verification program	Yes, plant specific	VII.E1.7-c, VII.E1.8-b.
BWR/ PWR	Neutron absorbing sheets in spent fuel storage racks	Reduction of neutron absorbing capacity and loss of material due to general corrosion (Boral, boron steel)	Plant specific	Yes, plant specific	VII.A2.1-b.

Table 3. Summary of Aging Management Programs for the Auxiliary Systems Evaluated in Chapter VII of the GALL Report (continued)

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Item Number in GALL
BWR/ PWR	New fuel rack assembly	Loss of material due to general, pitting, and crevice corrosion	Structures monitoring	No	VII.A1.1-a.
BWR/ PWR	Neutron absorbing sheets in spent fuel storage racks	Reduction of neutron absorbing capacity due to Boraflex degradation	Boraflex monitoring	No	VII.A2.1-a.
BWR/ PWR	Spent fuel storage racks and valves in spent fuel pool cooling and cleanup	Crack initiation and growth due to stress corrosion cracking	Water chemistry	No	VII.A2.1-c, VII.A3.3-b.
BWR/ PWR	Closure bolting and external surfaces of carbon steel and low-alloy steel components	Loss of material due to boric acid corrosion	Boric acid corrosion	No	VII.A3.1-a, VII.A3.2-b, VII.A3.2-c, VII.A3.3-c, VII.A3.4-b, VII.A3.5-b, VII.A3.6-a, VII.E1.1-b, VII.E1.2-a, VII.E1.3-b, VII.E1.4-a, VII.E1.5-b, VII.E1.6-a, VII.E1.7-b, VII.E1.8-d, VII.E1.9-a, VII.E1.10-a, VII.I.1-a.
BWR/ PWR	Components in or serviced by closed-cycle cooling water system	Loss of material due to general, pitting, and crevice corrosion, and MIC	Closed-cycle cooling water system	No	VII.A3.4-a, VII.A4.4-a, VII.C2.1-a, VII.C2.2-a, VII.C2.3-a, VII.C2.4-a, VII.C2.5-a, VII.E1.8-c, VII.E3.4-b, VII.F1.3-a, VII.F2.3-a, VII.F3.3-a, VII.F4.3-a, VII.H2.1-a.

Table 3. Summary of Aging Management Programs for the Auxiliary Systems Evaluated in Chapter VII of the GALL Report (continued)

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Item Number in GALL
BWR/ PWR	Cranes including bridge and trolleys and rail system in load handling system	Loss of material due to general corrosion and wear	Overhead heavy load and light load handling systems	No	VII.B.1-b, VII.B.2-a.
BWR/ PWR	Components in or serviced by open-cycle cooling water systems	Loss of material due to general, pitting, crevice, and galvanic corrosion, MIC, and biofouling; buildup of deposit due to biofouling	Open-cycle cooling water system	No	VII.C1.1-a, VII.C1.2-a, VII.C1.3-a, VII.C1.3-b, VII.C1.4-a, VII.C1.5-a, VII.C1.6-a, VII.C3.1-a, VII.C3.2-a, VII.C3.3-a, VII.H2.1-b.
BWR/ PWR	Buried piping and fittings	Loss of material due to general, pitting, and crevice corrosion, and MIC	Buried piping and tanks surveillance or Buried piping and tanks inspection	No Yes, detection of aging effects and operating experience are to be further evaluated	VII.C1.1-b, VII.H1.1-b.
BWR/ PWR	Components in compressed air system	Loss of material due to general and pitting corrosion	Compressed air monitoring	No	VII.D.1-a, VII.D.2-a, VII.D.3-a, VII.D.4-a, VII.D.5-a, VII.D.6-a.
BWR/ PWR	Components (doors and barrier penetra-tion seals) and concrete structures in fire protection	Loss of material due to wear; hardening and shrinkage due to weathering	Fire protection	No	VII.G.1-a, VII.G.1-d, VII.G.2-a, VII.G.2-d, VII.G.3-a, VII.G.3-d, VII.G.4-a, VII.G.4-d, VII.G.5-c.

Table 3. Summary of Aging Management Programs for the Auxiliary Systems Evaluated in Chapter VII of the GALL Report (continued)

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Item Number in GALL
BWR/ PWR	Components in water-based fire protection	Loss of material due to general, pitting, crevice, and galvanic corrosion, MIC, and biofouling	Fire water system	No	VII.G.6-a, VII.G.6-b.
BWR/ PWR	Components in diesel fire system	Loss of material due to galvanic, general, pitting, and crevice corrosion	Fire protection and fuel oil chemistry	No	VII.G.8-a.
BWR/ PWR	Tanks in diesel fuel oil system	Loss of material due to general, pitting, and crevice corrosion	Aboveground carbon steel tanks	No	VII.H1.4-b.
BWR/ PWR	Closure bolting	Loss of material due to general corrosion; crack initiation and growth due to cyclic loading and SCC	Bolting integrity	No	VII.I.2-a, VII.I.2-b.
BWR	Components in contact with sodium penta-borate solution in standby liquid control system (BWR)	Crack initiation and growth due to SCC	Water chemistry	No	VII.E2.1-a, VII.E2.2-a, VII.E2.3-a, VII.E2.4-a.
BWR	Components in reactor water cleanup system	Crack initiation and growth due to SCC and IGSCC	Reactor water cleanup system inspection	No	VII.E3.1-a, VII.E3.2-a.
BWR	Components in shutdown cooling system (older BWR)	Crack initiation and growth due to SCC	BWR stress corrosion cracking and water chemistry	No	VII.E4.1-c, VII.E4.3-a.
BWR	Components in shutdown cooling system (older BWR)	Loss of material due to pitting and crevice corrosion, and MIC	Closed-cycle cooling water system	No	VII.E4.4-a.

Table 3. Summary of Aging Management Programs for the Auxiliary Systems Evaluated in Chapter VII of the GALL Report (continued)

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Item Number in GALL
BWR/ PWR	Components (aluminum bronze, brass, cast iron, cast steel) in open-cycle and closed-cycle cooling water systems, and ultimate heat sink	Loss of material due to selective leaching	Selective leaching of materials	No	VII.C1.1-a, VII.C1.1-c, VII.C1.2-a, VII.C1.3-a, VII.C1.5-a, VII.C2.3-a, VII.C3.1-a, VII.C3.2-a.
BWR/ PWR	Fire barriers, walls, ceilings, and floors in fire protection	Concrete cracking and spalling due to freeze-thaw, aggressive chemical attack, and reaction with aggregates; loss of material due to corrosion of embedded steel	Fire protection and structures monitoring	No	VII.G.1-b, VII.G.1-c, VII.G.2-b, VII.G.2-c, VII.G.3-b, VII.G.3-c, VII.G.4-b, VII.G.4-c, VII.G.5-a, VII.G.5-b.

Table 4. Summary of Aging Management Programs for the Steam and Power Conversion System Evaluated in Chapter VIII of the GALL Report

Type	Component	Aging Effect/ Mechanism	Aging Effect/ Mechanism	Further Evaluation Recommended	Item Number in GALL
PWR/ BWR	Piping and fittings in main feedwater line, steam line and auxiliary feedwater (AFW) piping (PWR only)	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA	VIII.B1.1-b, VIII.B2.1-c, VIII.D1.1-b, VIII.D2.1-c, VIII.G.1-b.
PWR/ BWR	Piping and fittings, valve bodies and bonnets, pump casings, tanks, tubes, tubesheets, channel head, and shell (except main steam system)	Loss of material due to general (carbon steel only), pitting, and crevice corrosion	Water chemistry and one-time inspection	Yes, detection of aging effects is to be further evaluated	VIII.A.1-b, VIII.A.2-b, VIII.C.1-b, VIII.C.2-b, VIII.D1.1-c, VIII.D1.2-b, VIII.D1.3-a, VIII.D2.1-b, VIII.D2.2-b, VIII.D2.3-b, VIII.E.1-b, VIII.E.2-b, VIII.E.3-a, VIII.E.4-a, VIII.E.4-d, VIII.E.5-a, VIII.E.5-b, VIII.E.6-a, VIII.F.1-b, VIII.F.2-b, VIII.F.3-a, VIII.F.4-a, VIII.F.4-d, VIII.G.1-c, VIII.G.2-a, VIII.G.3-a, VIII.G.4-a, VIII.G.4-b.
PWR	AFW piping	Loss of material due to general, pitting, and crevice corrosion, MIC, and biofouling	Plant specific	Yes, plant specific	VIII.G.1-d.
PWR	Oil coolers in AFW system (lubricating oil side possibly contaminated with water)	Loss of material due to general (carbon steel only), pitting, and crevice corrosion, and MIC	Plant specific	Yes, plant specific	VIII.G.5-d.

Table 4. Summary of Aging Management Programs for the Steam and Power Conversion System Evaluated in Chapter VIII of the GALL Report (continued)

Type	Component	Aging Effect/ Mechanism	Aging Effect/ Mechanism	Further Evaluation Recommended	Item Number in GALL
BWR/ PWR	External surface of carbon steel components	Loss of material due to general corrosion	Plant specific	Yes, plant specific	VIII.H.1-b.
BWR/ PWR	Carbon steel piping and valve bodies	Wall thinning due to flow-accelerated corrosion	Flow-accelerated corrosion	No	VIII.A.1-a, VIII.A.2-a, VIII.B1.1-c, VIII.B1.2-b, VIII.B2.1-b, VIII.B2.2-a, VIII.C.1-a, VIII.C.2-a, VIII.D1.1-a, VIII.D1.2-a, VIII.D1.3-b, VIII.D2.1-a, VIII.D2.2-a, VIII.D2.3-a, VIII.E.1-a, VIII.E.2-a, VIII.F.1-a, VIII.F.2-a, VIII.G.1-a.
BWR/ PWR	Carbon steel piping and valve bodies in main steam system	Loss of material due to pitting and crevice corrosion	Water chemistry	No	VIII.B1.1-a, VIII.B1.2-a, VIII.B2.1-a, VIII.B2.2-b.
BWR/ PWR	Closure bolting in high-pressure or high-temperature systems	Loss of material due to general corrosion; crack initiation and growth due to cyclic loading and/or SCC.	Bolting integrity	No	VIII.H.2-a, VIII.H.2-b.
BWR/ PWR	Heat exchangers and coolers/ condensers serviced by open-cycle cooling water	Loss of material due to general (carbon steel only), pitting, and crevice corrosion, MIC, and biofouling; buildup of deposit due to biofouling	Open-cycle cooling water system	No	VIII.E.4-b, VIII.E.4-c, VIII.F.4-b, VIII.F.4-c, VIII.G.5-a, VIII.G.5-b.
BWR/ PWR	Heat exchangers and coolers/ condensers serviced by closed-cycle cooling water	Loss of material due to general (carbon steel only), pitting, and crevice corrosion	Closed-cycle cooling water system	No	VIII.E.4-e, VIII.F.4-e, VIII.G.5-c.

Table 4. Summary of Aging Management Programs for the Steam and Power Conversion System Evaluated in Chapter VIII of the GALL Report (continued)

Type	Component	Aging Effect/ Mechanism	Aging Effect/ Mechanism	Further Evaluation Recommended	Item Number in GALL
BWR/ PWR	External surface of aboveground condensate storage tank	Loss of material due to general (carbon steel only), pitting, and crevice corrosion	Aboveground carbon steel tanks	No	VIII.E.5-c, VIII.G.4-c.
BWR/ PWR	External surface of buried condensate storage tank and AFW piping	Loss of material due to general, pitting, and crevice corrosion, and MIC	Buried piping and tanks surveillance or Buried piping and tanks inspection	No Yes, detection of aging effects and operating experience are to be further evaluated	VIII.E.5-d, VIII.G.1-e, VIII.G.4-d.
PWR	External surface of carbon steel components	Loss of material due to boric acid corrosion	Boric acid corrosion	No	VIII.H.1-a.

Table 5. Summary of Aging Management Programs for the Structures and Component Supports Evaluated in Chapters II and III of the GALL Report

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	GALL Item Number
Common Components of All Types of PWR and BWR Containment					
BWR/ PWR	Penetration sleeves, penetration bellows, and dissimilar metal welds	Cumulative fatigue damage (CLB fatigue analysis exists)	TLAA evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA	II.A3.1-b, II.B4.1-b.
BWR/ PWR	Penetration sleeves, bellows, and dissimilar metal welds	Cracking due to cyclic loading; crack initiation and growth due to SCC	Containment inservice inspection (ISI) and containment leak rate test	Yes, detection of aging effects is to be evaluated	II.A3.1-c, II.A3.1-d, II.B4.1-c, II.B4.1-d.
BWR/ PWR	Penetration sleeves, penetration bellows, and dissimilar metal welds	Loss of material due to corrosion	Containment ISI and Containment leak rate test	No	II.A3.1-a, II.B4.1-a.
BWR/ PWR	Personnel airlock and equipment hatch	Loss of material due to corrosion	Containment ISI and containment leak rate test	No	II.A3.2-a, II.B4.2-a.
BWR/ PWR	Personnel airlock and equipment hatch	Loss of leak tightness in closed position due to mechanical wear of locks, hinges, and closure mechanisms	Containment leak rate test and plant technical specifications	No	II.A3.2-b, II.B4.2-b.
BWR/ PWR	Seals, gaskets, and moisture barriers	Loss of sealant and leakage through containment due to deterioration of joint seals, gaskets, and moisture barriers	Containment ISI and containment leak rate test	No	II.A3.3-a, II.B4.3-a.

Table 5. Summary of Aging Management Programs for the Structures and Component Supports Evaluated in Chapters II and III of the GALL Report (continued)

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	GALL Item Number
PWR Concrete (Reinforced and Prestressed) and Steel Containment BWR Concrete (Mark II and III) and Steel (Mark I, II, and III) Containment					
BWR/ PWR	Concrete elements: foundation, dome, and wall	Aging of accessible and inaccessible concrete areas due to leaching of calcium hydroxide, aggressive chemical attack, and corrosion of embedded steel	Containment ISI	Yes, if aging mechanism is significant for inaccessible areas	II.A1.1-b, II.A1.1-c, II.A1.1-e, II.A2.2-b, II.A2.2-c, II.A2.2-e, II.B2.2.1-a, II.B2.2.1-b, II.B2.2.1-d, II.B3.1.2-a, II.B3.1.2-b, II.B3.1.2-d, II.B3.2.1-b, II.B3.2.1-c, II.B3.2.1-e.
BWR/ PWR	Concrete elements: foundation	Cracks, distortion, and increases in component stress level due to settlement	Structures monitoring	No, if within the scope of the applicant's structures monitoring program	II.A1.1-f, II.A2.2-f, II.B2.2.1-e, II.B3.1.2-e, II.B3.2.1-f.
BWR/ PWR	Concrete elements: foundation	Reduction in foundation strength due to erosion of porous concrete subfoundation	Structures monitoring	No, if within the scope of the applicant's structures monitoring program	II.A1.1-g, II.A2.2-g, II.B2.2.1-f, II.B3.1.2-f, II.B3.2.1-g.
BWR/ PWR	Concrete elements: foundation, dome, and wall	Reduction of strength and modulus due to elevated temperature	Plant specific	Yes, for any portions of concrete containment that exceed specified temperature limits	II.A1.1-h, II.A2.2-h, II.B2.2.1-g, II.B3.1.2-g, II.B3.2.1-h.
BWR/ PWR	Prestressed containment: tendons and anchorage components	Loss of prestress due to relaxation, shrinkage, creep, and elevated temperature	TLAA evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA	II.A1.3-b, II.B2.2.3-b.

Table 5. Summary of Aging Management Programs for the Structures and Component Supports Evaluated in Chapters II and III of the GALL Report (continued)

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	GALL Item Number
BWR/ PWR	Steel elements: liner plate and containment shell	Loss of material due to corrosion in accessible and inaccessible areas	Containment ISI and containment leak rate test	Yes, if corrosion is significant for inaccessible areas	II.A1.2-a, II.A2.1-a, II.B1.1.1-a, II.B2.1.1-a, II.B2.2.2-a, II.B3.1.1-a, II.B3.2.2-a.
BWR	Steel elements: vent header, drywell head, torus, downcomers, and pool shell	Cumulative fatigue damage(CLB fatigue analysis exists)	TLAA evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA	II.B1.1.1-c, II.B2.1.1-c, II.B2.2.2-d.
BWR/ PWR	Steel elements: protected by coating	Loss of material due to corrosion in accessible areas only	Protective coating monitoring and maintenance	No	II.A1.2-a, II.A2.1-a, II.B1.1.1-a, II.B2.1.1-a, II.B2.2.2-a, II.B3.1.1-a, II.B3.2.2-a.
BWR/ PWR	Prestressed containment: tendons and anchorage components	Loss of material due to corrosion of prestressing tendons and anchorage components	Containment ISI	No	II.A1.3-a, II.B2.2.3-a.
BWR/ PWR	Concrete elements: foundation, dome, and wall	Scaling, cracking, and spalling due to freeze-thaw; expansion and cracking due to reaction with aggregate	Containment ISI	No	II.A1.1-a, II.A1.1-d, II.A2.2-a, II.A2.2-d, II.B2.2.1-c, II.B3.1.2-c, II.B3.2.1-a, II.B3.2.1-d.
BWR	Steel elements: vent line bellows, vent headers, and downcomers	Cracking due to cyclic loads; crack initiation and growth due to SCC	Containment ISI and Containment leak rate test	Yes, detection of aging effects is to be evaluated	II.B1.1.1-b, II.B1.1.1-d, II.B2.1.1-b, II.B2.2.2-c.
BWR	Steel elements: suppression chamber liner	Crack initiation and growth due to SCC	Containment ISI and containment leak rate test	No	II.B2.2.2-b, II.B3.1.1-b, II.B3.2.2-b.

Table 5. Summary of Aging Management Programs for the Structures and Component Supports Evaluated in Chapters II and III of the GALL Report (continued)

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	GALL Item Number
BWR	Steel elements: drywell head and downcomer pipes	Fretting and lock up due to wear	Containment ISI	No	II.B1.1.1-e, II.B2.1.1-d, II.B2.2.2-e.
Class I Structures					
BWR/ PWR	All Groups except Group 6: accessible interior/exterior concrete and steel components	All types of aging effects	Structures monitoring	No, if within the scope of the applicant's structures monitoring program	III.A1.1-a, III.A1.1-b, III.A1.1-c, III.A1.1-d, III.A1.1-f, III.A1.2-a, III.A2.1-a, III.A2.1-b, III.A2.1-c, III.A2.1-d, III.A2.1-f, III.A2.2-a, III.A3.1-a, III.A3.1-b, III.A3.1-c, III.A3.1-d, III.A3.1-f, III.A3.2-a, III.A4.1-a, III.A4.1-b, III.A4.1-d, III.A4.2-a, III.A4.2-b, III.A5.1-a, III.A5.1-b, III.A5.1-c, III.A5.1-d, III.A5.1-f, III.A5.2-a, III.A7.1-a, III.A7.1-b, III.A7.1-c, III.A7.1-d, III.A7.1-f, III.A7.2-a, III.A8.1-a,

Table 5. Summary of Aging Management Programs for the Structures and Component Supports Evaluated in Chapters II and III of the GALL Report (continued)

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	GALL Item Number
BWR/ PWR	All Groups except Group 6: accessible interior/exterior concrete and steel components	All types of aging effects	Structures monitoring	No, if within the scope of the applicant's structures monitoring program	III.A8.1-b, III.A8.1-c, III.A8.2-a, III.A9.1-a, III.A9.1-b, III.A9.1-c, III.A9.1-d, III.A9.1-f.
BWR/ PWR	Groups 1-3, 5, 7-9: inaccessible concrete components, such as exterior walls below grade and foundation	Aging of inaccessible concrete areas due to aggressive chemical attack, and corrosion of embedded steel	Plant specific	Yes, if an aggressive below-grade environment exists	III.A1.1-e, III.A1.1-g, III.A2.1-e, III.A2.1-g, III.A3.1-e, III.A3.1-g, III.A5.1-e, III.A5.1-g, III.A7.1-e, III.A7.1-g, III.A8.1-d, III.A8.1-e, III.A9.1-e, III.A9.1-g.
BWR/ PWR	Group 6: all accessible/ inaccessible concrete, steel, and earthen components	All types of aging effects, including loss of material due to abrasion, cavitation, and corrosion	Inspection of water-control structures or FERC/US Army Corp of Engineers dam inspection and maintenance	No	III.A6.1-a, III.A6.1-b, III.A6.1-c, III.A6.1-d, III.A6.1-e, III.A6.1-f, III.A6.1-h, III.A6.2-a, III.A6.4-a.
BWR/ PWR	Group 5: liners	Crack initiation and growth due to SCC; loss of material due to crevice corrosion	Water chemistry and monitoring of spent fuel pool water level	No	III.A5.2-b.
BWR/ PWR	Groups 1-3, 5, 6: all masonry block walls	Cracking due to restraint, shrinkage, creep, and aggressive environment	Masonry wall	No	III.A1.3-a, III.A2.3-a, III.A3.3-a, III.A5.3-a, III.A6.3-a.

Table 5. Summary of Aging Management Programs for the Structures and Component Supports Evaluated in Chapters II and III of the GALL Report (continued)

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	GALL Item Number
BWR/ PWR	Groups 1-3, 5, 7-9: foundation	Cracks, distortion, and increases in component stress level due to settlement	Structures monitoring	No, if within the scope of the applicant's structures monitoring program	III.A1.1-h, III.A2.1-h, III.A3.1-h, III.A5.1-h, III.A7.1-h, III.A8.1-f, III.A9.1-h.
BWR/ PWR	Groups 1-3, 5-9: foundation	Reduction in foundation strength due to erosion of porous concrete subfoundation	Structures monitoring	No, if within the scope of the applicant's structures monitoring program	III.A1.1-i, III.A2.1-i, III.A3.1-i, III.A5.1-i, III.A6.1-g, III.A7.1-i, III.A8.1-g, III.A9.1-i.
BWR/ PWR	Groups 1-5: concrete	Reduction of strength and modulus due to elevated temperature	Plant specific	Yes, for any portions of concrete that exceed specified temperature limits	III.A1.1-j, III.A2.1-j, III.A3.1-j, III.A4.1-c, III.A5.1-j.
BWR/ PWR	Groups 7, 8: liners	Crack Initiation and growth due to SCC; loss of material due to crevice corrosion	Plant specific	Yes	III.A7.2-b, III.A8.2-b.
Component Supports					
BWR/ PWR	All Groups: support members: anchor bolts, concrete surrounding anchor bolts, welds, grout pad, bolted connections, etc.	Aging of component supports	Structures monitoring	No, if within the scope of the applicant's structures monitoring program	III.B1.1.4-a, III.B1.2.3-a, III.B1.3.3-a, III.B2.1-a, III.B2.2-a, III.B3.1-a, III.B3.2-a, III.B4.1-a, III.B4.2-a, III.B4.3-a, III.B5.1-a, III.B5.2-a.

Table 5. Summary of Aging Management Programs for the Structures and Component Supports Evaluated in Chapters II and III of the GALL Report (continued)

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	GALL Item Number
BWR/ PWR	Groups B1.1, B1.2, and B1.3: support members: anchor bolts and welds	Cumulative fatigue damage (CLB fatigue analysis exists)	TLAA evaluated in accordance with 10 CFR 54.21(c)	Yes, TLAA	III.B1.1.1-c, III.B1.2.1-c, III.B1.3.1-b.
PWR	All Groups: support members: anchor bolts and welds	Loss of material due to boric acid corrosion	Boric acid corrosion	No	III.B1.1.1-b, III.B1.2.1-b, III.B2.1-b, III.B3.1-b, III.B4.1-b, III.B5.1-b.
BWR/ PWR	Groups B1.1, B1.2, and B1.3: support members: anchor bolts, welds, spring hangers, guides, stops, and vibration isolators	Loss of material due to environmental corrosion; loss of mechanical function due to corrosion, distortion, dirt, overload, etc.	ISI	No	III.B1.1.1-a, III.B1.1.3-a, III.B1.2.1-a, III.B1.2.2-a, III.B1.3.1-a. III.B1.3.2-a.
BWR/ PWR	Group B1.1: high strength low-alloy bolts	Crack initiation and growth due to SCC	Bolting integrity	No	III.B1.1.2-a.

Table 6. Summary of Aging Management Programs for the Electrical Components Evaluated in Chapter VI of the GALL Report

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Item Number in GALL
BWR/ PWR	Electrical equip-ment subject to 10 CFR 50.49 environmental qualification (EQ) require-ments	Degradation due to various aging mechanisms	Environmental qualification of electric components	Yes, TLAA	VI.B.1-a.
BWR/ PWR	Electrical cables and connections not subject to 10 CFR 50.49 EQ requirements	Embrittlement, cracking, melting, discoloration, swelling, or loss of dielectric strength leading to reduced insulation resistance (IR); electrical failure caused by thermal/ thermoxidative degradation of organics; radiolysis and photolysis (ultraviolet [UV] sensitive materials only) of organics; radiation-induced oxidation; moisture intrusion	Aging manage-ment program for electrical cables and connections not subject to 10 CFR 50.49 EQ requirements	No	VI.A.1-a.
BWR/ PWR	Electrical cables used in instrumentation circuits not subject to 10 CFR 50.49 EQ requirements that are sensitive to reduction in conductor insulation resistance	Embrittlement, cracking, melting, discoloration, swelling, or loss of dielectric strength leading to reduced IR; electrical failure caused by thermal/ thermoxidative degradation of organics; radiation-induced oxidation; moisture intrusion	Aging manage-ment program for electrical cables used in instrumentation circuits not subject to 10 CFR 50.49 EQ requirements	No	VI.A.1-b.

Table 6. Summary of Aging Management Programs for Electrical Components Evaluated in Chapter VI of the GALL Report (continued)

Type	Component	Aging Effect/ Mechanism	Aging Management Programs	Further Evaluation Recommended	Item Number in GALL
BWR/ PWR	Inaccessible medium-voltage (2kV to 15kV) cables (e.g., installed in conduit or direct buried) not subject to 10 CFR 50.49 EQ requirements	Formation of water trees; localized damage leading to electrical failure (breakdown of insulation) caused by moisture intrusion and water trees	Aging management program for inaccessible medium-voltage cables not subject to 10 CFR 50.49 EQ requirements	No	VI.A.1-c.
PWR	Electrical connectors not subject to 10 CFR 50.49 EQ requirements that are exposed to borated water leakage	Corrosion of connector contact surfaces caused by intrusion of borated water	Boric acid corrosion	No	VI.A.2-a.

APPENDIX

PLANT SYSTEMS EVALUATED IN THE GALL REPORT (VOLUME 2)

LISTS OF ITEM NUMBERS IN THE GALL REPORT (VOLUME 2)

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BWR	High-pressure coolant injection	V.D2
BWR	High-pressure core spray	V.D2
BWR	Low-pressure coolant injection and residual heat removal	V.D2
BWR	Low-pressure core spray	V.D2
BWR	Reactor building	III.A1
BWR	Reactor building with steel superstructure	III.A2
BWR	Reactor coolant pressure boundary	IV.C1
BWR	Reactor coolant system connected systems (up to and including the second isolation valve): Automatic depressurization system Feedwater High-pressure core spray High-pressure coolant injection Isolation condenser Low-pressure coolant injection Low-pressure core spray Main steam Reactor core isolation cooling Reactor water cleanup Recirculation system Residual heat removal Shutdown cooling Standby liquid control	 IV.C1 IV.C1 IV.C1 IV.C1 IV.C1 IV.C1 IV.C1 IV.C1 IV.C1 IV.C1 IV.C1 IV.C1 IV.C1 IV.C1
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BWR/PWR	Auxiliary building, diesel generator building, radwaste building, turbine building, switchgear room, auxiliary feedwater pump house, and utility/piping tunnels	III.A3
BWR/PWR	Carbon steel components	V.E, VII.I, VIII.H
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Plant Systems
Evaluated in the GALL Report (Volume 2) (continued)

Type	System	Section in GALL (Vol. 2)
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BWR/PWR	Control room area ventilation system	VII.F1
BWR/PWR	Demineralized water makeup	Not in scope of 10 CFR 50.54
BWR/PWR	Diesel fuel oil system	VII.H1
BWR/PWR	Diesel generator building ventilation system	VII.F4
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BWR/PWR	Extraction steam system	VIII.C
BWR/PWR	Feedwater system	VIII.D2, D1
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BWR/PWR	Overhead heavy load and light load (related to refueling) handling systems	VII.B
BWR/PWR	Potable and sanitary water	Not in scope of 10 CFR 50.54
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BWR/PWR	Refueling canal	III.A5
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Plant Systems
Evaluated in the GALL Report (Volume 2) (continued)

Type	System	Section in GALL (Vol. 2)
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PWR	High-pressure safety injection	V.D1
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PWR	Low-pressure safety injection	V.D1
PWR	Shield building	III.A1
PWR	Reactor coolant system and connected lines (up to and including the second isolation valve): Chemical and volume control system Core flood system Drains and instrumentation lines High-pressure injection system Low-pressure injection Residual heat removal or shutdown cooling Safety injection Sampling system	 IV.C2 IV.C2 IV.C2 IV.C2 IV.C2 IV.C2 IV.C2 IV.C2
PWR	Reactor coolant system, pressurizer, pressurizer relief tank, and other Class 1 components	IV.C2
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II. Containment Structures

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II.A1	**Concrete containments (reinforced and prestressed)**
II.A1.1	Concrete elements
II.A1.2	Steel elements
II.A1.3	Prestressing system
II.A2	**Steel containments**
II.A2.1	Steel elements
II.A2.2	Concrete elements
II.A3	**Common components**
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II.A3.2	Personnel airlock and equipment hatch
II.A3.3	Seals, gaskets, and moisture barriers (caulking, flashing, and other sealants)
II.B	**Boiling water reactor (BWR) containments**
II.B1	**Mark I containments**
II.B1.1	Steel containments
II.B1.1.1	Steel elements
II.B2	**Mark II containments**
II.B2.1	Steel containments
II.B2.1.1	Steel elements
II.B2.2	Concrete containments
II.B2.2.1	Concrete elements
II.B2.2.2	Steel elements
II.B2.2.3	Prestressing system
II.B3	**Mark III containments**
II.B3.1	Steel containments
II.B3.1.1	Steel elements
II.B3.1.2	Concrete elements
II.B3.2	Concrete containments
II.B3.2.1	Concrete elements
II.B3.2.2	Steel elements
II.B4	**Common components**
II.B4.1	Penetration sleeves, penetration bellows, and dissimilar metal welds
II.B4.2	Personnel airlock, equipment hatch, and control rod drive (CRD) hatch
II.B4.3	Seals, gaskets, and moisture barriers (caulking, flashing, and other sealants)

List of Item Numbers in the GALL Report
III. Class 1 Structures and Component Supports

Item Number in GALL	Description
III.A	**Class 1 structures**
III.A1	**Group 1 structures (BWR reactor building, PWR shield building, and control room/building)**
III.A1.1	Concrete elements
III.A1.2	Steel elements
III.A1.3	Masonry walls
III.A2	**Group 2 structures (BWR reactor building with steel superstructure)**
III.A2.1	Concrete elements
III.A2.2	Steel elements
III.A2.3	Masonry walls
III.A3	**Group 3 structures (auxiliary building, diesel generator building, radwaste building, turbine building, switchgear room, auxiliary feedwater (AFW) pumphouse, and utility/piping tunnels)**
III.A3.1	Concrete elements
III.A3.2	Steel elements
III.A3.3	Masonry walls
III.A4	**Group 4 structures (containment internal structures, excluding refueling canal)**
III.A4.1	Concrete elements
III.A4.2	Steel elements
III.A5	**Group 5 structures (fuel storage facility, refueling canal)**
III.A5.1	Concrete elements
III.A5.2	Steel elements
III.A5.3	Masonry walls
III.A6	**Group 6 structures (water control structures)**
III.A6.1	Concrete elements
III.A6.2	Steel elements
III.A6.3	Masonry walls
III.A6.4	Earthen water control structures
III.A7	**Group 7 structures (concrete tanks)**
III.A7.1	Concrete elements
III.A7.2	Steel elements
III.A8	**Group 8 structures (steel tanks)**
III.A8.1	Concrete elements
III.A8.2	Steel elements
III.A9	**Group 9 structures (BWR unit vent stack)**
III.A9.1	Concrete elements
III.B	**Component supports**
III.B1	**Supports for ASME piping and components**
III.B1.1	Supports for ASME Class 1 piping and components
III.B1.1.1	Support members; welds, bolted connections; support anchorage to building structure
III.B1.1.2	High-strength bolts for NSSS component supports
III.B1.1.3	Constant/variable load spring hangers; guides; stops; sliding surfaces; design clearances; vibration isolators
III.B1.1.4	Building concrete at locations of expansion and grouted anchors; grout pads for support base plates
III.B1.2	Supports for ASME Class 2 and 3 piping and components
III.B1.2.1	Support members; welds, bolted connections; support anchorage to building structure

List of Item Numbers in the GALL Report
III. Class I Structures and Component Supports (continued)

Item Number in GALL	Description
III.B1.2.2	Constant/variable load spring hangers; guides; stops; sliding surfaces; design clearances; vibration isolators
III.B1.2.3	Building concrete at locations of expansion and grouted anchors; grout pads for support base plates
III.B1.3	Supports for ASME Class MC components (BWR containment supports)
III.B1.3.1	Support members; welds, bolted connections; support anchorage to building structure
III.B1.3.2	Guides; stops; sliding surfaces; design clearances
III.B1.3.3	Building concrete at locations of expansion and grouted anchors; grout pads for support base plates
III.B2	**Supports for cable trays, conduits, HVAC ducts, tube track, instrument tubing, and non-ASME piping and components**
III.B2.1	Support members; welds; bolted connections; support anchorage to building structure
III.B2.2	Building concrete at locations of expansion and grouted anchors; grout pads for support base plates
III.B3	**Anchorage of racks, panels, cabinets, and enclosures for electric equipment and instrumentation**
III.B3.1	Support members; welds; bolted connections; support anchorage to building structure
III.B3.2	Building concrete at locations of expansion and grouted anchors; grout pads for support base plates
III.B4	**Supports for emergency diesel generator (EDG), HVAC system components, and other miscellaneous mechanical equipment**
III.B4.1	Support members; welds; bolted connections; support anchorage to building structure
III.B4.2	Vibration isolation elements
III.B4.3	Building concrete at locations of expansion and grouted anchors; grout pads for support base plates
III.B5	**Supports for platforms, pipe whip restraints, jet impingement shields, masonry walls, and other miscellaneous steel structures**
III.B5.1	Support members; welds; bolted connections; support anchorage to building structure
III.B5.2	Building concrete at locations of expansion and grouted anchors; grout pads for support base plates

List of Item Numbers in the GALL Report
IV.A1. Reactor Vessel (BWR)

Item Number in GALL	Description
IV.A1.1	**Top head enclosure**
IV.A1.1.1	Top head
IV.A1.1.2	Nozzles [vent, top head spray or reactor core isolation cooling (RCIC), and spare]
IV.A1.1.3	Head flange
IV.A1.1.4	Closure studs and nuts
IV.A1.1.5	Vessel flange leak detection line
IV.A1.2	**Vessel shell**
IV.A1.2.1	Vessel flange
IV.A1.2.2	Upper shell
IV.A1.2.3	Intermediate nozzle shell
IV.A1.2.4	Intermediate beltline shell
IV.A1.2.5	Lower shell
IV.A1.2.6	Beltline welds
IV.A1.2.7	Attachment welds
IV.A1.3	**Nozzles**
IV.A1.3.1	Main steam
IV.A1.3.2	Feedwater
IV.A1.3.3	CRD return line
IV.A1.3.4	Low-pressure coolant injection (LPCI) or residual heat removal (RHR) injection mode
IV.A1.4	**Nozzles safe ends**
IV.A1.4.1	High-pressure core spray (HPCS)
IV.A1.4.2	Low-pressure core spray (LPCS)
IV.A1.4.3	CRD return line
IV.A1.4.4	Recirculating water (inlet and outlet)
IV.A1.4.5	LPCI or RHR injection mode
IV.A1.5	**Penetrations**
IV.A1.5.1	CRD stub tubes
IV.A1.5.2	Instrumentation
IV.A1.5.3	Jet pump instrument
IV.A1.5.4	Standby liquid control
IV.A1.5.5	Flux monitor
IV.A1.5.6	Drain line
IV.A1.6	**Bottom head**
IV.A1.7	**Support skirt and attachment welds**

List of Item Numbers in the GALL Report
IV.A2. Reactor Vessel (PWR)

Item Number in GALL	Description
IV.A2.1	**Closure head**
IV.A2.1.1	Dome
IV.A2.1.2	Head flange
IV.A2.1.3	Stud assembly
IV.A2.1.4	Vessel flange leak detection line
IV.A2.2	**Control rod drive (CRD) head penetration**
IV.A2.2.1	Nozzle
IV.A2.2.2	Pressure housing
IV.A2.2.3	Flange bolting
IV.A2.3	**Nozzles**
IV.A2.3.1	Inlet
IV.A2.3.2	Outlet
IV.A2.3.3	Safety injection (on some)
IV.A2.4	**Nozzle safe ends**
IV.A2.4.1	Inlet
IV.A2.4.2	Outlet
IV.A2.4.3	Safety injection (on some)
IV.A2.5	**Shell**
IV.A2.5.1	Upper (nozzle) shell
IV.A2.5.2	Intermediate and lower shell
IV.A2.5.3	Vessel flange
IV.A2.5.4	Bottom head
IV.A2.6	**Core support pads/core guide lugs**
IV.A2.7	**Penetrations**
IV.A2.7.1	Instrumentation tubes (bottom head)
IV.A2.7.2	Head vent pipe (top head)
IV.A2.7.3	Instrument tubes (top head)
IV.A2.8	**Pressure vessel support**
IV.A2.8.1	Skirt support
IV.A2.8.2	Cantilever/column support
IV.A2.8.3	Neutron shield tank

List of Item Numbers in the GALL Report
IV.B1. Reactor Vessel Internals (BWR)

Item Number in GALL	Description
IV.B1.1	**Core shroud, shroud head, and core plate**
IV.B1.1.1	Core shroud (upper, central, and lower)
IV.B1.1.2	Core plate
IV.B1.1.3	Core plate bolts
IV.B1.1.4	Access hole cover
IV.B1.1.5	Shroud support structure
IV.B1.1.6	LPCI coupling
IV.B1.2	**Top guide**
IV.B1.3	**Core spray lines and spargers**
IV.B1.3.1	Core spray lines (headers)
IV.B1.3.2	Spray ring
IV.B1.3.3	Spray nozzles
IV.B1.3.4	Thermal sleeve
IV.B1.4	**Jet pump assemblies**
IV.B1.4.1	Thermal sleeve
IV.B1.4.2	Inlet header
IV.B1.4.3	Riser brace arm
IV.B1.4.4	Holddown beams
IV.B1.4.5	Inlet elbow
IV.B1.4.6	Mixing assembly
IV.B1.4.7	Diffuser
IV.B1.4.8	Castings
IV.B1.4.9	Jet pump sensing line
IV.B1.5	**Fuel support and CRD assemblies**
IV.B1.5.1	Orificed fuel support
IV.B1.5.2	CRD housing
IV.B1.6	**Instrumentation**
IV.B1.6.1	Intermediate range monitor (IRM) dry tubes
IV.B1.6.2	Low-power range monitor (LPRM) dry tubes
IV.B1.6.3	Source range monitor (SRM) dry tubes
IV.B1.6.4	Incore neutron flux monitor guide tubes

List of Item Numbers in the GALL Report
IV.B2. Reactor Vessel Internals (PWR) – Westinghouse

Item Number in GALL	Description
IV.B2.1	**Upper internals assembly**
IV.B2.1.1	Upper support plate
IV.B2.1.2	Upper support column
IV.B2.1.3	Upper support column bolts
IV.B2.1.4	Upper core plate
IV.B2.1.5	Upper core plate alignment pins
IV.B2.1.6	Fuel alignment pins
IV.B2.1.7	Hold-down spring
IV.B2.2	**RCCA guide tube assemblies**
IV.B2.2.1	RCCA guide tubes
IV.B2.2.2	RCCA guide tube bolts
IV.B2.2.3	RCCA guide tube support pins
IV.B2.3	**Core barrel**
IV.B2.3.1	Core barrel
IV.B2.3.2	Core barrel flange
IV.B2.3.3	Core barrel outlet nozzles
IV.B2.3.4	Thermal shield
IV.B2.4	**Baffle/former assembly**
IV.B2.4.1	Baffle/former plates
IV.B2.4.2	Baffle/former bolts
IV.B2.5	**Lower internal assembly**
IV.B2.5.1	Lower core plate
IV.B2.5.2	Fuel alignment pins
IV.B2.5.3	Lower support forging or casting
IV.B2.5.4	Lower support plate columns
IV.B2.5.5	Lower support plate column bolts
IV.B2.5.6	Radial support keys and clevis inserts
IV.B2.5.7	Clevis insert bolts
IV.B2.6	**Instrumentation support structure**
IV.B2.6.1	Flux thimble guide tubes
IV.B2.6.2	Flux thimbles

List of Item Numbers in the GALL Report
IV.B3. Reactor Vessel Internals (PWR) – Combustion Engineering

Item Number in GALL	Description
IV.B3.1	**Upper internals assembly**
IV.B3.1.1	Upper guide structure support plate
IV.B3.1.2	Fuel alignment plate
IV.B3.1.3	Fuel alignment plate guide lugs and guide lug inserts
IV.B3.1.4	Hold-down ring
IV.B3.2	**Control-core element assembly (CEA) shroud assemblies**
IV.B3.2.1	CEA shrouds
IV.B3.2.2	CEA shrouds bolts
IV.B3.2.3	CEA shrouds extension shaft guides
IV.B3.3	**Core support barrel**
IV.B3.3.1	Core support barrel
IV.B3.3.2	Core support barrel upper flange
IV.B3.3.3	Core support barrel alignment keys
IV.B3.4	**Core shroud assembly**
IV.B3.4.1	Core shroud assembly
IV.B3.4.2	Core shroud assembly bolts
IV.B3.4.3	Core shroud tie rods
IV.B3.5	**Lower internal assembly**
IV.B3.5.1	Core support plate
IV.B3.5.2	Fuel alignment pins
IV.B3.5.3	Lower support structure beam assemblies
IV.B3.5.4	Core support column
IV.B3.5.5	Core support column bolts
IV.B3.5.6	Core support barrel snubber assemblies

List of Item Numbers in the GALL Report
IV.B4. Reactor Vessel Internals (PWR) – Babcock & Wilcox (B&W)

Item Number in GALL	Description
IV.B4.1	**Plenum cover and plenum cylinder**
IV.B4.1.1	Plenum cover assembly
IV.B4.1.2	Plenum cylinder
IV.B4.1.3	Reinforcing plates
IV.B4.1.4	Top flange-to-cover bolts
IV.B4.1.5	Bottom flange-to-upper grid screws
IV.B4.2	**Upper grid assembly**
IV.B4.2.1	Upper grid rib section
IV.B4.2.2	Upper grid ring forging
IV.B4.2.3	Fuel assembly support pads
IV.B4.2.4	Plenum rib pads
IV.B4.2.5	Rib-to-ring screws
IV.B4.3	**Control rod guide tube (CRGT) assembly**
IV.B4.3.1	CRGT pipe and flange
IV.B4.3.2	CRGT spacer casting
IV.B4.3.3	CRGT spacer screws
IV.B4.3.4	Flange-to-upper grid screws
IV.B4.3.5	CRGT rod guide tubes
IV.B4.3.6	CRGT rod guide sectors
IV.B4.4	**Core support shield assembly**
IV.B4.4.1	Core support shield cylinder (top and bottom flange)
IV.B4.4.2	Core support shield-to-core barrel bolts
IV.B4.4.3	Outlet and vent valve nozzles
IV.B4.4.4	Vent valve body and retaining ring
IV.B4.4.5	Vent valve assembly locking device
IV.B4.5	**Core barrel assembly**
IV.B4.5.1	Core barrel cylinder (top and bottom flange)
IV.B4.5.2	Lower internals assembly-to-core barrel bolts
IV.B4.5.3	Core barrel-to-thermal shield bolts
IV.B4.5.4	Baffle plates and formers
IV.B4.5.5	Baffle/former bolts and screws
IV.B4.6	**Lower grid (LG) assembly**
IV.B4.6.1	Lower grid rib section
IV.B4.6.2	Fuel assembly support pads
IV.B4.6.3	Lower grid rib-to-shell forging screws
IV.B4.6.4	Lower grid flow distributor plate
IV.B4.6.5	Orifice plugs
IV.B4.6.6	Lower grid and shell forgings
IV.B4.6.7	Lower internals assembly-to-thermal shield bolts
IV.B4.6.8	Guide blocks and bolts
IV.B4.6.9	Shock pads and bolts
IV.B4.6.10	Support post pipes
IV.B4.6.11	Incore guide tube spider castings

List of Item Numbers in the GALL Report
IV.B4. Reactor Vessel Internals (PWR) – Babcock & Wilcox (B&W) (continued)

Item Number in GALL	Description
IV.B4.7	**Flow distributor**
IV.B4.7.1	Flow distributor head and flange
IV.B4.7.2	Shell forging-to-flow distributor bolts
IV.B4.7.3	Incore guide support plate
IV.B4.7.4	Clamping ring
IV.B4.8	**Thermal shield**

List of Item Numbers in the GALL Report
IV.C1. Reactor Coolant Pressure Boundary (BWR)

Item Number in GALL	Description
IV.C1.1	**Piping and fittings**
IV.C1.1.1	Main steam
IV.C1.1.2	Feedwater
IV.C1.1.3	High-pressure coolant injection (HPCI) system
IV.C1.1.4	Reactor core isolation cooling (RCIC) system
IV.C1.1.5	Recirculation
IV.C1.1.6	Residual heat removal (RHR) system
IV.C1.1.7	Low pressure coolant injection (LPCI) system
IV.C1.1.8	Low pressure core spray (LPCS) system
IV.C1.1.9	High pressure core spray (HPCS) system
IV.C1.1.10	Lines to isolation condenser
IV.C1.1.11	Lines to reactor water cleanup (RWC) and standby liquid control (SLC) systems
IV.C1.1.12	Steam line to HPCI and RCIC pump turbine
IV.C1.1.13	Small bore piping less than NPS 4
IV.C1.2	**Recirculation pump**
IV.C1.2.1	Casing
IV.C1.2.2	Cover
IV.C1.2.3	Seal flange
IV.C1.2.4	Closure bolting
IV.C1.3	**Valves**
IV.C1.3.1	Body
IV.C1.3.2	Bonnet
IV.C1.3.3	Seal flange
IV.C1.3.4	Closure bolting
IV.C1.4	**Isolation condenser**
IV.C1.4.1	Tubing
IV.C1.4.2	Tubesheet
IV.C1.4.3	Channel head
IV.C1.4.4	Shell

List of Item Numbers in the GALL Report
IV.C2. Reactor Coolant System and Connected Lines (PWR)

Item Number in GALL	Description
IV.C2.1	**Reactor coolant system piping and fittings**
IV.C2.1.1	Cold-leg
IV.C2.1.2	Hot-leg
IV.C2.1.3	Surge line
IV.C2.1.4	Spray line
IV.C2.1.5	Small-bore reactor coolant system (RCS) piping, fittings, and branch connections less than NPS 4
IV.C2.2	**Connected systems piping and fittings**
IV.C2.2.1	RHR or low-pressure injection system (decay heat removal [DHR]/shutdown system)
IV.C2.2.2	Core flood system (CFS)
IV.C2.2.3	High-pressure injection system (makeup and letdown functions)
IV.C2.2.4	Chemical and volume control system
IV.C2.2.5	Sampling system
IV.C2.2.6	Drains and instrument lines
IV.C2.2.7	Nozzles and safe ends
IV.C2.2.8	Small-bore piping, fittings, and branch connections less than NPS 4 in connected systems
IV.C2.3	**Reactor coolant pump**
IV.C2.3.1	Casing
IV.C2.3.2	Cover
IV.C2.3.3	Closure bolting
IV.C2.4	**Safety and relief valves**
IV.C2.4.1	Body
IV.C2.4.2	Bonnet
IV.C2.4.3	Closure bolting
IV.C2.5	**Pressurizer**
IV.C2.5.1	Shell/heads
IV.C2.5.2	Spray line nozzle
IV.C2.5.3	Surge line nozzle
IV.C2.5.4	Spray head
IV.C2.5.5	Thermal sleeves
IV.C2.5.6	Instrument penetrations
IV.C2.5.7	Safe ends
IV.C2.5.8	Manway and flanges
IV.C2.5.9	Manway and flange bolting
IV.C2.5.10	Heater sheaths and sleeves
IV.C2.5.11	Support keys, skirt, and shear lugs
IV.C2.5.12	Integral support
IV.C2.6	**Pressurizer relief tank**
IV.C2.6.1	Tank shell and heads
IV.C2.6.2	Flanges and nozzles

List of Item Numbers in the GALL Report
IV.D1. Steam Generator (Recirculating)

Item Number in GALL	Description
IV.D1.1	**Pressure boundary and structural**
IV.D1.1.1	Top head
IV.D1.1.2	Steam nozzle and safe end
IV.D1.1.3	Upper and lower shell
IV.D1.1.4	Transition cone
IV.D1.1.5	Feedwater nozzle and safe end
IV.D1.1.6	Feedwater impingement plate and support
IV.D1.1.7	Secondary manway and handhole bolting
IV.D1.1.8	Lower head
IV.D1.1.9	Primary nozzles and safe ends
IV.D1.1.10	Instrument nozzles
IV.D1.1.11	Primary manway (cover and bolting)
IV.D1.2	**Tube bundle**
IV.D1.2.1	Tubes and sleeves
IV.D1.2.2	Tube support lattice bars (combustion engineering [CE])
IV.D1.2.3	Tube plugs
IV.D1.2.4	Tube support plates
IV.D1.3	**Upper assembly and separators**
IV.D1.3.1	Feedwater inlet ring and support

List of Item Numbers in the GALL Report
IV.D2. Steam Generator (Once-Through)

Item Number in GALL	Description
IV.D2.1	**Pressure boundary and structural**
IV.D2.1.1	Upper and lower heads
IV.D2.1.2	Tube sheets
IV.D2.1.3	Primary nozzles and safe ends
IV.D2.1.4	Shell assembly
IV.D2.1.5	Feedwater and auxiliary feedwater nozzles and safe ends
IV.D2.1.6	Steam nozzles and safe ends
IV.D2.1.7	Primary side drain nozzles
IV.D2.1.8	Secondary side nozzles (vent, drain, and instrumentation)
IV.D2.1.9	Primary manways (cover and bolting)
IV.D2.1.10	Secondary manways and handholes (cover and bolting)
IV.D2.2	**Tube bundle**
IV.D2.2.1	Tubes and sleeves
IV.D2.2.2	Tube plugs

List of Item Numbers in the GALL Report
V.A. Containment Spray System (PWR)

Item Number in GALL	Description
V.A.1	**Piping, fittings and miscellaneous items**
V.A.1.1	Piping and fittings up to isolation valve
V.A.1.2	Flow orifice/elements
V.A.1.3	Temperature elements/indicators
V.A.1.4	Bolting
V.A.1.5	Eductors
V.A.2	**Headers and spray nozzles**
V.A.2.1	Piping and fittings
V.A.2.2	Flow orifice
V.A.2.3	Headers
V.A.2.4	Spray nozzles
V.A.3	**Pumps**
V.A.3.1	Bowl/casing
V.A.3.2	Bolting
V.A.4	**Valves (hand, control, check, motor-operated, and containment isolation) in containment spray system**
V.A.4.1	Body and bonnet
V.A.4.2	Bolting
V.A.5	**Valves (hand, control, and containment isolation) in headers and spray nozzles**
V.A.5.1	Body and bonnet
V.A.5.2	Bolting
V.A.6	**Containment spray heat exchanger**
V.A.6.1	Bonnet/cover
V.A.6.2	Tubing
V.A.6.3	Shell
V.A.6.4	Case/cover
V.A.6.5	Bolting

List of Item Numbers in the GALL Report
V.B. Standby Gas Treatment System (BWR)

Item Number in GALL	Description
V.B1	**Ductwork**
V.B.1.1	Duct fittings, access doors, and closure bolts
V.B.1.2	Equipment frames and housing
V.B.1.3	Seals between ducts and fan
V.B.1.4	Seals in dampers and doors
V.B.2	**Filters**
V.B.2.1	Housing and supports
V.B.2.2	Elastomer seals

List of Item Numbers in the GALL Report
V.C. Containment Isolation Components

Item Number in GALL	Description
V.C.1	**Isolation barriers**
V.C.1.1	Valve body and bonnet
V.C.1.2	Pipe penetrations

List of Item Numbers in the GALL Report
V.D1. Emergency Core Cooling System (PWR)

Item Number in GALL	Description
V.D1.1	**Piping and fittings**
V.D1.1.1	Core flood system (CFS)
V.D1.1.2	Residual heat removal (RHR) or shutdown cooling (SDC)
V.D1.1.3	High-pressure safety injection (HPSI)
V.D1.1.4	Low-pressure safety injection (LPSI)
V.D1.1.5	Connecting lines to chemical and volume control system (CVCS) and spent fuel pool (SFP) cooling
V.D1.1.6	Lines to emergency sump
V.D1.1.7	Bolting for flange connections
V.D1.2	**HPSI and LPSI pumps**
V.D1.2.1	Bowl/casing
V.D1.2.2	Bolting
V.D1.2.3	Orifice
V.D1.3	**Refueling water tank (RWT) circulation pump**
V.D1.3.1	Bolting
V.D1.4	**Valves**
V.D1.4.1	Body and bonnet
V.D1.4.2	Bolting
V.D1.5	**Heat exchangers (RCP, HPSI and LPSI pump seals, and RHR or SDC)**
V.D1.5.1	Bonnet/cover
V.D1.5.2	Tubing
V.D1.5.3	Shell
V.D1.5.4	Case/cover
V.D1.5.5	Bolting
V.D1.6	**Heat exchangers (RWT heating)**
V.D1.6.1	Bonnet/cover
V.D1.6.2	Tubing
V.D1.6.3	Shell
V.D1.6.4	Bolting
V.D1.7	**Safety injection tank (accumulator)**
V.D1.7.1	Shell
V.D1.7.2	Manway
V.D1.7.3	Penetrations/nozzles
V.D1.8	**Refueling water tank (RWT)**
V.D1.8.1	Shell
V.D1.8.2	Manhole
V.D1.8.3	Penetrations/nozzles
V.D1.8.4	Bolting
V.D1.8.5	Buried portion of tank

List of Item Numbers in the GALL Report
V.D2. Emergency Core Cooling System (BWR)

Item Number in GALL	Description
V.D2.1	**Piping and Fittings**
V.D2.1.1	High pressure coolant injection (HPCI)
V.D2.1.2	Reactor core isolation cooling (RCIC)
V.D2.1.3	High-pressure core spray (HPCS)
V.D2.1.4	Low-pressure core spray (LPCS)
V.D2.1.5	Low-pressure coolant injection (LPCI) and residual heat removal (RHR)
V.D2.1.6	Lines to suppression chamber (SC)
V.D2.1.7	Lines to drywell and suppression chamber spray system (DSCSS)
V.D2.1.8	Automatic depressurization system (ADS)
V.D2.1.9	Lines to HPCI and RCIC pump turbine
V.D2.1.10	Lines from HPCI and RCIC pump turbines to condenser
V.D2.2	**Pumps (HPCS or HPCI main and booster, LPCS, LPCI or RHR, and RCIC)**
V.D2.2.1	Bowl/casing
V.D2.2.2	Suction head
V.D2.2.3	Discharge head
V.D2.3	**Valves (check, control, hand, motor operated, and relief valves)**
V.D2.3.1	Body and bonnet
V.D2.4	**Heat exchangers (RHR and LPCI)**
V.D2.4.1	Tubes
V.D2.4.2	Tubesheet
V.D2.4.3	Channel head
V.D2.4.4	**Shell**
V.D2.5	**Drywell and suppression chamber spray system (DSCSS)**
V.D2.5.1	Piping and fittings
V.D2.5.2	Flow orifice
V.D2.5.3	Headers
V.D2.5.4	Spray nozzles

List of Item Numbers in the GALL Report
V.E. Carbon Steel Components

Item Number in GALL	Description
V.E.1	**Carbon steel components**
V.E.1.1	External surfaces
V.E.2	**Closure bolting**
V.E.2.1	In high-pressure or high-temperature systems

List of Item Numbers in the GALL Report
VI.A. Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements

Item Number in GALL	Description
VI.A.1	**Conductor insulation**
VI.A.1.1	Electrical cables and connections exposed to an adverse localized environment caused by heat, radiation, or moisture
VI.A.1.2	Electrical cables used in instrumentation circuits that are sensitive to reduction in conductor insulation resistance (IR) exposed to an adverse localized environment caused by heat, radiation, or moisture
VI.A.1.3	Inaccessible medium-voltage (2 kV to 15 kV) cables (e.g., installed in conduit or direct buried) exposed to an adverse localized environment caused by exposure to moisture and voltage
VI.A.2	**Connector contacts**
VI.A.2.1	Electrical connectors exposed to borated water leakage

List of Item Numbers in the GALL Report
VI.B. Equipment Subject to 10 CFR 50.49 Environmental Qualification Requirements

Item Number in GALL	Description
VI.B.1	**Equipment subject to 10 CFR 50.49 environmental qualification requirements**
VI.B.1.1	Electrical equipment subject to 10 CFR 50.49 environmental qualification (EQ) requirements

List of Item Numbers in the GALL Report
VII.A1. New Fuel Storage

Item Number in GALL	Description
VII.A1.1	**New fuel rack**
VII.A1.1.1	New fuel rack assembly

List of Item Numbers in the GALL Report
VII.A2. Spent Fuel Storage

Item Number in GALL	Description
VII.A2.1	**Spent fuel storage rack**
VII.A2.1.1	Neutron-absorbing sheets
VII.A2.1.2	Storage rack

List of Item Numbers in the GALL Report
VII.A3. Spent Fuel Pool Cooling and Cleanup (PWR)

Item Number in GALL	Description
VII.A3.1	**Piping**
VII.A3.1.1	Closure bolting
VII.A3.2	**Filter**
VII.A3.2.1	Housing
VII.A3.2.2	Closure bolting
VII.A3.2.3	Elastomer lining
VII.A3.3	**Valves (check and hand valves)**
VII.A3.3.1	Body and bonnet
VII.A3.3.2	Closure bolting
VII.A3.3.3	Elastomer lining (hand valves only)
VII.A3.4	**Heat exchanger**
VII.A3.4.1	Shell and access cover
VII.A3.4.2	Channel head and access cover
VII.A3.4.3	Closure bolting
VII.A3.5	**Ion exchanger**
VII.A3.5.1	Shell
VII.A3.5.2	Nozzles
VII.A3.5.3	Closure bolting
VII.A3.5.4	Elastomer lining
VII.A3.6	**Pump**
VII.A3.6.1	Closure bolting

List of Item Numbers in the GALL Report
VII.A4. Spent Fuel Pool Cooling and Cleanup (BWR)

Item Number in GALL	Description
VII.A4.1	**Piping**
VII.A4.1.1	Piping, fittings, and flanges
VII.A4.2	**Filter**
VII.A4.2.1	Housing
VII.A4.2.2	Elastomer lining
VII.A4.3	**Valves (check and hand valves)**
VII.A4.3.1	Body and bonnet
VII.A4.3.2	Elastomer lining (hand valves only)
VII.A4.4	**Heat exchanger**
VII.A4.4.1	Shell and access cover
VII.A4.4.2	Channel head and access cover
VII.A4.4.3	Tubes
VII.A4.4.4	Tubesheet
VII.A4.5	**Ion exchanger**
VII.A4.5.1	Shell
VII.A4.5.2	Nozzles
VII.A4.5.3	Elastomer lining
VII.A4.6	**Pump**
VII.A4.6.1	Casing

List of Item Numbers in the GALL Report
VII.A5. Suppression Pool Cleanup System (BWR)

See Evaluation Summary, page VII A5-1, in Volume 2 of the GALL report (NUREG-1801, March 2001).

List of Item Numbers in the GALL Report
VII.B. Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems

Item Number in GALL	Description
VII.B.1	**Cranes including bridge and trolley (for cranes that fall within the scope of 10 CFR 54)**
VII.B.1.1	Structural girders
VII.B.2	**Rail system**
VII.B.2.1	Rail

List of Item Numbers in the GALL Report
VII.C1. Open-Cycle Cooling Water System (Service Water System)

Item Number in GALL	Description
VII.C1.1	**Piping**
VII.C1.1.1	Piping and fittings
VII.C1.1.2	Underground piping and fittings
VII.C1.2	**Valves**
VII.C1.2.1	Body and bonnet
VII.C1.3	**Heat exchanger**
VII.C1.3.1	Shell
VII.C1.3.2	Channel
VII.C1.3.3	Channel head and access cover
VII.C1.3.4	Tubesheet
VII.C1.3.5	Tubes
VII.C1.4	**Flow orifice**
VII.C1.4.1	Body
VII.C1.5	**Pump**
VII.C1.5.1	Casing
VII.C1.6	**Basket strainer**
VII.C1.6.1	Body

List of Item Numbers in the GALL Report
VII.C2. Closed-Cycle Cooling Water System

Item Number in GALL	Description
VII.C2.1	**Piping**
VII.C2.1.1	Pipe, fittings, and flanges
VII.C2.2	**Valves (check, hand, control, relief, solenoid, and containment isolation valves)**
VII.C2.2.1	Body and bonnet
VII.C2.3	**Pump**
VII.C2.3.1	Casing
VII.C2.4	**Tank**
VII.C2.4.1	Shell
VII.C2.5	**Flow orifice**
VII.C2.5.1	Body

List of Item Numbers in the GALL Report
VII.C3. Ultimate Heat Sink

Item Number in GALL	Description
VII.C3.1	**Piping**
VII.C3.1.1	Piping and fittings
VII.C3.2	**Valves (check, hand, and control valves)**
VII.C3.2.1	Body and bonnet
VII.C3.3	**Pump**
VII.C3.3.1	Casing

List of Item Numbers in the GALL Report
VII.D. Compressed Air System

Item Number in GALL	Description
VII.D.1	**Piping**
VII.D.1.1	Piping and fittings
VII.D.1.2	Closure bolting
VII.D.2	**Valves (including check valves and containment isolation valves)**
VII.D.2.1	Body and bonnet
VII.D.2.2	Closure bolting
VII.D.3	**Air receiver**
VII.D.3.1	Shell and access cover
VII.D.3.2	Closure bolting
VII.D.4	**Pressure regulators**
VII.D.4.1	Body and bonnet
VII.D.5	**Filter**
VII.D.5.1	Shell and access cover
VII.D.5.2	Closure bolting
VII.D.6	**Dryer**
VII.D.6.1	Shell and access cover
VII.D.6.2	Closure bolting

List of Item Numbers in the GALL Report
VII.E1. Chemical and Volume Control System (PWR)

Item Number in GALL	Description
VII.E1.1	**High-pressure piping (1,500 psig rating)**
VII.E1.1.1	Pipe, fittings, and flanges
VII.E1.1.2	Closure bolting
VII.E1.2	**Low-pressure piping (150 psig rating)**
VII.E1.2.1	Closure bolting
VII.E1.3	**High-pressure valves (check, control, hand, motor-operated, pressure control, and relief valves)**
VII.E1.3.1	Body and bonnet
VII.E1.3.2	Closure bolting
VII.E1.4	**Low-pressure valves (check, control, hand, motor-operated, pressure control, and relief valves)**
VII.E1.4.1	Closure bolting
VII.E1.5	**High-pressure pump**
VII.E1.5.1	Casing
VII.E1.5.2	Closure bolting
VII.E1.6	**Low-pressure pump**
VII.E1.6.1	Closure bolting
VII.E1.7	**Regenerative heat exchanger**
VII.E1.7.1	Channel head and access cover
VII.E1.7.2	Tubesheet
VII.E1.7.3	Tubes
VII.E1.7.4	Shell and access cover
VII.E1.7.5	Closure bolting
VII.E1.8	**Letdown heat exchanger**
VII.E1.8.1	Channel head and access cover
VII.E1.8.2	Tubesheet
VII.E1.8.3	Tubes
VII.E1.8.4	Shell and access cover
VII.E1.8.5	Closure bolting
VII.E1.9	**Basket strainers**
VII.E1.9.1	Closure bolting
VII.E1.10	**Volume control tank**
VII.E1.10.1	Closure bolting

List of Item Numbers in the GALL Report
VII.E2. Standby Liquid Control System (BWR)

Item Number in GALL	Description
VII.E2.1	**Piping**
VII.E2.1.1	Piping and fittings
VII.E2.2	**Solution storage**
VII.E2.2.1	Tank
VII.E2.2.2	Tank heaters
VII.E2.3	**Valves (pump suction, relief, injection, containment isolation, and explosive actuated discharge valves)**
VII.E2.3.1	Body and bonnet
VII.E2.4	**Injection pumps**
VII.E2.4.1	Casing

List of Item Numbers in the GALL Report
VII.E3. Reactor Water Cleanup System (BWR)

Item Number in GALL	Description
VII.E3.1	**Piping**
VII.E3.1.1	Piping and fittings (beyond second isolation valves)
VII.E3.2	**Reactor water cleanup (RWCU) pump**
VII.E3.2.1	Casing
VII.E3.3	**Regenerative heat exchanger**
VII.E3.3.1	Channel head and access cover
VII.E3.3.2	Tubesheet
VII.E3.3.3	Tubes
VII.E3.3.4	Shell and access cover
VII.E3.4	**Nonregenerative heat exchanger**
VII.E3.4.1	Channel head and access cover
VII.E3.4.2	Tubesheet
VII.E3.4.3	Tubes
VII.E3.4.4	Shell and access cover

List of Item Numbers in the GALL Report
VII.E4. Shutdown Cooling System (Older BWR)

Item Number in GALL	Description
VII.E4.1	**Piping**
VII.E4.1.1	Piping and fittings
VII.E4.2	**Pump**
VII.E4.2.1	Casing
VII.E4.3	**Valves (check, control, hand, motor-operated, and relief valves)**
VII.E4.3.1	Body and bonnet
VII.E4.4	**Heat Exchanger**
VII.E4.4.1	Channel head and access cover
VII.E4.4.2	Tubesheet
VII.E4.4.3	Tubes
VII.E4.4.4	Shell and access cover

List of Item Numbers in the GALL Report
VII.F1. Control Room Area Ventilation System

Item Number in GALL	Description
VII.F1.1	**Duct**
VII.F1.1.1	Duct fittings, access doors, and closure bolts
VII.F1.1.2	Equipment frames and housing
VII.F1.1.3	Flexible collars between ducts and fans
VII.F1.1.4	Seals in dampers and doors
VII.F1.2	**Air handler heating/cooling**
VII.F1.2.1	Heating/cooling coils
VII.F1.3	**Piping**
VII.F1.3.1	Piping and fittings
VII.F1.4	**Filters**
VII.F1.4.1	Housing and supports
VII.F1.4.2	Elastomer seals

List of Item Numbers in the GALL Report
VII.F2. Auxiliary and Radwaste Area Ventilation System

Item Number in GALL	Description
VII.F2.1	**Duct**
VII.F2.1.1	Duct fittings, access doors, and closure bolts
VII.F2.1.2	Equipment frames and housing
VII.F2.1.3	Flexible collars between ducts and fans
VII.F2.1.4	Seals in dampers and doors
VII.F2.2	**Air handler heating/cooling**
VII.F2.2.1	Heating/cooling coils
VII.F2.3	**Piping**
VII.F2.3.1	Piping and fittings
VII.F2.4	**Filters**
VII.F2.4.1	Housing and supports
VII.F2.4.2	Elastomer seals

List of Item Numbers in the GALL Report
VII. F3. Primary Containment Area Ventilation System

Item Number in GALL	Description
VII.F3.1	**Duct**
VII.F3.1.1	Duct fittings, access doors, and closure bolts
VII.F3.1.2	Equipment frames and housing
VII.F3.1.3	Flexible collars between ducts and fans
VII.F3.1.4	Seals in dampers and doors
VII.F3.2	**Air handler heating/cooling**
VII.F3.2.1	Heating/cooling coils
VII.F3.3	**Piping**
VII.F3.3.1	Piping and fittings
VII.F3.4	**Filters**
VII.F3.4.1	Housing and supports
VII.F3.4.2	Elastomer seals

List of Item Numbers in the GALL Report
VII.F4. Diesel Generator Building Ventilation System

Item Number in GALL	Description
VII.F4.1	**Duct**
VII.F4.1.1	Duct fittings, access doors, and closure bolts
VII.F4.1.2	Equipment frames and housing
VII.F4.1.3	Flexible collars between ducts and fans
VII.F4.1.4	Seals in dampers and doors
VII.F4.2	**Air handler heating/cooling**
VII.F4.2.1	Heating/cooling coils
VII.F4.3	**Piping**
VII.F4.3.1	Piping and fittings

List of Item Numbers in the GALL Report
VII.G. Fire Protection

Item Number in GALL	Description
VII.G.1	**Intake structure**
VII.G.1.1	Fire barrier penetration seals
VII.G.1.2	Fire barrier walls, ceilings, and floors
VII.G.1.3	Fire rated doors
VII.G.2	**Turbine building**
VII.G.2.1	Fire barrier penetration seals
VII.G.2.2	Fire barrier walls, ceilings, and floors
VII.G.2.3	Fire rated doors
VII.G.3	**Auxiliary building**
VII.G.3.1	Fire barrier penetration seals
VII.G.3.2	Fire barrier walls, ceilings, and floors
VII.G.3.3	Fire rated doors
VII.G.4	**Diesel generator building**
VII.G.4.1	Fire barrier penetration seals
VII.G.4.2	Fire barrier walls, ceilings, and floors
VII.G.4.3	Fire rated doors
VII.G.5	**Primary containment**
VII.G.5.1	Fire barrier walls, ceilings, and floors
VII.G.5.2	Fire rated doors
VII.G.6	**Water-based fire protection system**
VII.G.6.1	Piping and fittings
VII.G.6.2	Filter, fire hydrants, mulsifier, pump casing, sprinkler, strainer, and valve bodies (including containment isolation valves)
VII.G.7	**Reactor coolant pump oil collection system**
VII.G.7.1	Tank
VII.G.7.2	Piping, tubing, and valve bodies
VII.G.8	**Diesel fire system**
VII.G.8.1	Diesel-driven fire pump and fuel supply line

List of Item Numbers in the GALL Report
VII.H1. Diesel Fuel Oil System

Item Number in GALL	Description
VII.H1.1	**Piping**
VII.H1.1.1	Aboveground pipe and fittings
VII.H1.1.2	Underground pipe and fittings
VII.H1.2	**Valves**
VII.H1.2.1	Body and bonnet
VII.H1.2.2	Closure bolting
VII.H1.3	**Pump**
VII.H1.3.1	Casing
VII.H1.3.2	Closure bolting
VII.H1.4	**Tank**
VII.H1.4.1	Internal surfaces
VII.H1.4.2	External surfaces

List of Item Numbers in the GALL Report
VII.H2. Emergency Diesel Generator System

Item Number in GALL	Description
VII.H2.1	**Diesel engine cooling water subsystem**
VII.H2.1.1	Pipe and fittings
VII.H2.2	**Diesel engine starting air subsystem**
VII.H2.2.1	Pipe and fittings
VII.H2.2.2	Valves (hand and check)
VII.H2.2.3	Drain trap
VII.H2.2.4	Air accumulator vessel
VII.H2.3	**Diesel engine combustion air intake subsystem**
VII.H2.3.1	Piping and fittings
VII.H2.3.2	Filter
VII.H2.3.3	Muffler
VII.H2.4	**Diesel engine combustion air exhaust subsystem**
VII.H2.4.1	Piping and fittings
VII.H2.4.2	Muffler
VII.H2.5	**Diesel engine fuel oil subsystem**
VII.H2.5.1	Tanks (day and drip)

List of Item Numbers in the GALL Report
VII.I. Carbon Steel Components

Item Number in GALL	Description
VII.I.1	**Carbon steel components**
VII.I.1.1	External surfaces
VII.I.2	**Closure bolting**
VII.I.2.1	In high-pressure or high-temperature systems

List of Item Numbers in the GALL Report
VIII.A. Steam Turbine System

Item Number in GALL	Description
VIII.A.1	**Piping and fittings**
VIII.A.1.1	High-pressure (HP) turbine to moisture separator/reheater (MSR)
VIII.A.1.2	MSR to low-pressure (LP) turbine
VIII.A.2	**Valves (stop, control or governor, intermediate stop and control or combined intermediate, bypass or steam dumps, atmospheric dumps, main steam safety, or safety/relief)**
VIII.A.2.1	Body and bonnet

List of Item Numbers in the GALL Report
VIII.B1. Main Steam System (PWR)

Item Number in GALL	Description
VIII.B1.1	**Piping and fittings**
VIII.B1.1.1	Steam lines from steam generator to isolation valves (Group B or C)
VIII.B1.1.2	Steam lines from isolation valves to main turbine (Group D)
VIII.B1.1.3	Lines to feedwater (FW) and auxiliary feedwater (AFW) pump turbines
VIII.B1.1.4	Lines to moisture separator/reheater (MSR)
VIII.B1.1.5	Turbine bypass
VIII.B1.1.6	Steam drains
VIII.B1.2	**Valves (check, control, hand, motor operated, safety, and containment isolation valves)**
VIII.B1.2.1	Body and bonnet

List of Item Numbers in the GALL Report
VIII.B2. Main Steam System (BWR)

Item Number in GALL	Description
VIII.B2.1	**Piping and fittings**
VIII.B2.1.1	Steam lines to main turbine (Group B)
VIII.B2.1.2	Steam lines to main turbine (Group D)
VIII.B2.1.3	Lines to FW pump turbines
VIII.B2.1.4	Turbine bypass
VIII.B2.1.5	Steam drains
VIII.B2.1.6	Steam line to HPCI turbine
VIII.B2.1.7	Steam line to RCIC turbine
VIII.B2.2	**Valves (check, control, hand, motor-operated, and safety valves)**
VIII.B2.2.1	Body and bonnet

List of Item Numbers in the GALL Report
VIII.C. Extraction Steam System

Item Number in GALL	Description
VIII.C.1	**Piping and fittings**
VIII.C.1.1	Lines to feedwater heaters
VIII.C.1.2	Steam drains
VIII.C.2	**Valves**
VIII.C.2.1	Body and bonnet

List of Item Numbers in the GALL Report
VIII.D1. Feedwater Systems (PWR)

Item Number in GALL	Description
VIII.D1.1	**Main feedwater line**
VIII.D1.1.1	Pipe and fittings (Group B, C, or D)
VIII.D1.2	**Valves (control, check, hand, safety, and containment isolation valves)**
VIII.D1.2.1	Body and bonnet
VIII.D1.3	**Feedwater pump (steam turbine and motor driven)**
VIII.D1.3.1	Casing
VIII.D1.3.2	Suction and discharge lines

List of Item Numbers in the GALL Report
VIII.D2. Feedwater Systems (BWR)

Item Number in GALL	Description
VIII.D2.1	**Main feedwater line**
VIII.D2.1.1	Pipe and fittings (Group B or D)
VIII.D2.2	**Valves (control, check, and hand valves)**
VIII.D2.2.1	Body and bonnet
VIII.D2.3	**Feedwater pump (steam turbine and motor driven)**
VIII.D2.3.1	Casing
VIII.D2.3.2	Suction and discharge lines

List of Item Numbers in the GALL Report
VIII.E. Condensate System

Item Number in GALL	Description
VIII.E.1	**Condensate lines**
VIII.E.1.1	Piping and fittings
VIII.E.2	**Valves**
VIII.E.2.1	Body and bonnet
VIII.E.3	**Condensate pumps (main and booster pumps)**
VIII.E.3.1	Casing
VIII.E.4	**Condensate coolers/condensers**
VIII.E.4.1	Tubes
VIII.E.4.2	Tubesheet
VIII.E.4.3	Channel head
VIII.E.4.4	Shell
VIII.E.5	**Condensate storage**
VIII.E.5.1	Tank
VIII.E.6	**Condensate cleanup system**
VIII.E.6.1	Piping and fittings
VIII.E.6.2	Demineralizer
VIII.E.6.3	Strainer

List of Item Numbers in the GALL Report
VIII.F. Steam Generator Blowdown System (PWR)

Item Number in GALL	Description
VIII.F.1	**Blowdown lines**
VIII.F.1.1	Pipe and fittings (Group B)
VIII.F.1.2	Pipe and fittings (Group D)
VIII.F.2	**Valves (including containment isolation valves)**
VIII.F.2.1	Body and bonnet
VIII.F.3	**Blowdown pump**
VIII.F.3.1	Casing
VIII.F.4	**Blowdown heat exchanger**
VIII.F.4.1	Tubes
VIII.F.4.2	Tubesheet
VIII.F.4.3	Channel head and access cover
VIII.F.4.4	Shell and access cover

List of Item Numbers in the GALL Report
VIII.G. Auxiliary Feedwater (AFW) System (PWR)

Item Number in GALL	Description
VIII.G.1	**Auxiliary feedwater piping**
VIII.G.1.1	Pipe and fittings (above ground)
VIII.G.1.2	Pipe and fittings (buried)
VIII.G.2	**AFW pumps (steam turbine and motor driven)**
VIII.G.2.1	Casing
VIII.G.2.2	Suction and discharge lines
VIII.G.3	**Valves (control, check, hand, and containment isolation valves)**
VIII.G.3.1	Body and bonnet
VIII.G.4	**Condensate storage (emergency)**
VIII.G.4.1	Tank
VIII.G.5	**Bearing oil coolers** (for steam turbine pump)
VIII.G.5.1	Shell
VIII.G.5.2	Tubes
VIII.G.5.3	Tubesheet

List of Item Numbers in the GALL Report
VIII.H. Carbon Steel Components

Item Number in GALL	Description
VIII.H.1	**Carbon steel components**
VIII.H.1.1	External surfaces
VIII.H.2	**Closure bolting**
VIII.H.2.1	In high-pressure or high-temperature systems